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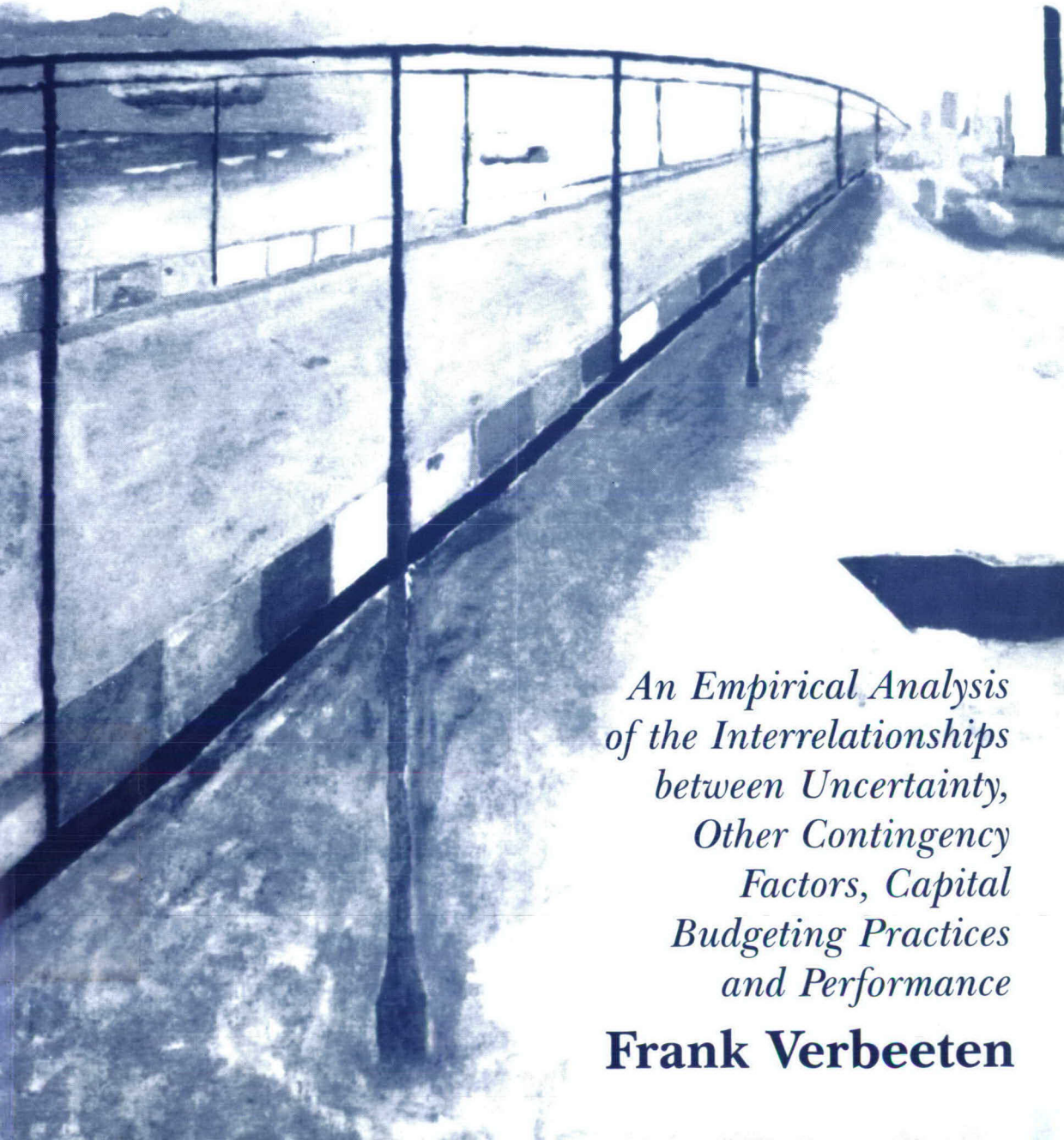

An Empirical Analysis of the Interrelationships between Uncertainty, Other Contingency Factors, Capital Budgeting Practices and Performance

Frank Verbeeten

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Proefschrift ter verkrijging van de graad van doctor aan
de Katholieke Universiteit Brabant, op gezag van de Rector Magnificus,
Prof. Dr. F.A. van der Duyn Schouten,
in het openbaar te verdedigen ten overstaan van een door
het college voor promoties aangewezen commissie in de aula van de
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door

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To my family:

To my parents – for motivation

To Irene – for support

To Jasper & ? – for inspiration

Preface

This thesis provides the results from a study on how uncertainty affects capital budgeting practices. I was motivated by a desire to increase my "intellectual luggage" as much as possible after finishing my previous masters-studies. As a result, the first choice of a subject for a thesis was very broad. In the beginning of 1994, I planned to investigate how uncertainty affects the design of management control systems. Having identified all the elements that the term "management control systems" enhances (operational and cash flow budgeting, reward systems, information systems, etc.), it has been decided to focus on capital budgeting practices.

Writing a thesis is – although sometimes lonely – not something that you do just by yourself, as I've experienced over the past few years. Many people have provided support, motivation and inspiration by just asking how I was doing with my research project. At a certain point in time, some people may have been afraid to ask this question, wondering whether I would ever finish this project. All those who read this preface may be assured that the questions (carefully phrased as they may have been) regarding the continuance of my project have stimulated me to continue on the (sometimes long and winding) road to the end of this project.

Acknowledgements are in particular due to my thesis supervisors, Rob Bannink and Bert Bettonvil, for the opportunities they have given me to discuss earlier versions of this manuscript. Rob Bannink's comments provided new insights and helped me to sharpen my view on specific issues in this thesis. Bert Bettonvil has been very important in determining how, from a statistical point of view, the research project should be executed. The research project has greatly benefited from their comments; at the same time, they gave me the freedom to make my own decisions.

Furthermore, I would like to thank my colleagues at Deloitte & Touche (and its predecessor, HRS). They provided a pleasant and stimulating working environment in which there was (eventually) enough time to work on my thesis. Now that the work is finished, the phrase "sometime we'll look back at this (project) and think it is funny" on one coffee cup at work has certainly become true. Second, I would like to thank the partners in the firm for encouraging me to undertake this investigation, even though projects such as this may interfere with the (short term) profit objectives of a consulting firm.

Most of all, I would like to thank Irene for her patience and unconditional support during the project. She helped me considerably to put my troubles during the process in perspective by stressing that there are more important things in life than working on a doctoral thesis. Also, she endured the many hours that I was working on this study without complaint – that is, most of the time. Jasper and ? provided an incentive to finish this project; they, and Irene, are entitled to the time that has been claimed by this research project.

Frank Verbeeten
Utrecht, February 2001

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Samenvatting

De Invloed van Onzekerheid op Investeringspraktijken

In de voorliggende dissertatie wordt geanalyseerd of een specifieke contingency factor (in casu onzekerheid), alleen of in samenhang met andere contingency factoren (waaronder omgeving, technologie, strategie, omvang en bedrijfstak), in de praktijk van invloed is op de methoden en technieken die voor het nemen van investeringsbeslissingen worden gebruikt. Tevens wordt beoordeeld of het gebruik van de "juiste" methoden en technieken van invloed is op de prestaties van de organisatie.

In het eerste hoofdstuk worden de relevante begrippen kort geïntroduceerd. In de eerste paragraaf wordt de centrale probleemstelling geponeerd. Vervolgens worden de voor deze dissertatie relevante begrippen (management accounting systeem, investeringspraktijken, onzekerheid, contingency factoren, prestaties) besproken; daarbij worden tevens de resultaten van een aantal voorgaande onderzoeken op dit terrein gepresenteerd en geanalyseerd. Na het aangeven van het praktische belang van het onderzoek worden de opzet van het onderzoek en de leeswijzer in dit hoofdstuk gepresenteerd.

In hoofdstuk 2 wordt nader ingegaan op de definities van de voor het onderzoek relevante variabelen. De relevante variabelen worden tevens in meer detail dan in het voorgaande hoofdstuk besproken. Het management accounting systeem is gedefinieerd als het systeem dat financiële en niet-financiële informatie levert om de beslissingen te kunnen nemen, alsmede om te beoordelen of de doelstellingen van de organisatie gerealiseerd gaan worden. Investeringspraktijken zijn gedefinieerd als alle procedures, voorschriften, methoden en technieken die gebruikt worden om investeringsmogelijkheden te onderkennen, om de initiële ideeën verder uit te werken tot specifieke investerings-voorstellen, om een investeringsproject te evalueren en te selecteren en om het investeringsproject te beheersen. Vervolgens is de contingency theorie besproken; de belangrijkste contingency variabele in dit onderzoek is onzekerheid. Tenslotte zijn vijf prestatie-indicatoren (vier financiële, objectieve indicatoren: rendement op eigen vermogen, rendement op totaal vermogen; de "reward-to-variability ratio's" voor deze indicatoren; en een subjectieve, niet-financiële indicator: effectiviteit) gedefinieerd waarmee wordt geëvalueerd of een "match" tussen onzekerheid en investeringspraktijken in betere prestaties resulteert.

In het derde hoofdstuk wordt het theoretische raamwerk gepresenteerd. Aangegeven wordt welke onderzoeken op dit terrein eerder hebben plaatsgevonden, op welke wijze in deze onderzoeken de relevante variabelen (investeringspraktijken, onzekerheid, andere contingency variabelen en de prestaties) zijn gedefinieerd en gemeten en op welke wijze deze variabelen in dit onderzoek gemeten gaan worden. De belangrijkste proposities van dit onderzoek zijn dat (1) hoge [lage] onzekerheid is gerelateerd aan geavanceerde [simpele] investeringspraktijken, dat (2) andere contingency factoren [in samenhang met onzekerheid] zijn gerelateerd aan specifieke investeringspraktijken en dat (3) een sterkere "pasvorm" tussen onzekerheid [andere contingency factoren] en investeringspraktijken resulteert in betere prestaties. Het theoretisch raamwerk (met de verwachte onderlinge verbanden) is gepresenteerd in figuur 3.7.

In hoofdstuk 4 komen methodologie en dataverzameling aan de orde. Gekozen is voor een enquête bij circa 700 grote bedrijven in Nederland. Het onderzoek richt zich op organisaties met een omzet boven *f* 60 mln. (€ 27 mln.), een totaal vermogen boven *f* 45 mln. (€ 20 mln.) en personeelskosten boven *f* 35 mln. (€ 16 mln.). Dit laatste criterium is gehanteerd om organisaties te selecteren met minimaal 400 personeelsleden (een maatstaf voor omvang die ook in andere onderzoeken is gehanteerd). De opzet is vergelijkbaar met andere onderzoeken op dit terrein. Gezien het feit dat uit eerdere onderzoeken blijkt dat de financiële afdeling vaak bij investeringsbeslissingen is betrokken, zijn de enquêtes aan de financieel directeur of de controller van de desbetreffende organisatie gericht. Uiteindelijk hebben 189 organisaties de enquête teruggestuurd, een respons van circa 27%. In de steekproef zijn fabricage, gas-, water- en elektrabedrijven en financiële instellingen oververtegenwoordigd, terwijl de overheid en de dienstverlenende industrie ondervertegenwoordigd zijn.

Het vijfde hoofdstuk gaat in op de wijze waarop organisaties in de praktijk hun investeringsbeslissingen nemen. De resultaten van het onderzoek geven de huidige stand van zaken met betrekking tot de investeringspraktijken in het Nederlandse bedrijfsleven weer. De stand van zaken in Nederland lijkt in grote mate overeen te komen met die in andere (Westerse) landen. Op basis van de enquête-resultaten zijn de organisaties geclassificeerd in drie groepen. De classificatie is gebaseerd op de meest geavanceerde methodieken die binnen de organisatie worden gebruikt; klaarblijkelijk gaan organisaties in de loop der tijd meer technieken gebruiken in plaats van andere technieken. Overigens kunnen de definities van "simpel" en "geavanceerd" verschillen van de definities die in andere onderzoeken zijn gehanteerd. In andere onderzoeken is het gebruik van DCF-methoden vaak voldoende om als "geavanceerd" te kwalificeren; in dit onderzoek gelden aanvullende voorwaarden.

Vervolgens is geanalyseerd in hoeverre onzekerheid van invloed is op de investeringspraktijken van een organisatie. Het blijkt dat een toename van de onzekerheid in een aantal specifieke factoren (onzekerheden omtrent wisselkoers, rente, inflatie, afzetmarkt, aansprakelijkheid, krediet en gedrag) geassocieerd is met de toepassing van meer geavanceerde investeringspraktijken. Op basis van deze gegevens worden voor investeringspraktijken relevante onzekerheidsscores (RUS en BRUS) afgeleid, die in het vervolg van het onderzoek worden gehanteerd. Zowel RUS als BRUS blijkt sterk samen te hangen met β; β lijkt echter sterk samen te hangen met een beperkt aantal onzekerheden. Vervolgens is de relatie tussen een aantal andere contingency factoren (omgeving, technologie, omvang en bedrijfstak) en investeringspraktijken onderzocht. Het blijkt dat naast onzekerheid ook technologische veranderingen (nieuwe factor), investeringsstrategie (nieuwe factor), en omvang van invloed zijn op de investeringspraktijken. Op basis van de onderzoeksresultaten is het mogelijk om een "multiple contingency profiel" af te leiden voor investeringspraktijken.

In hoofdstuk 6 komt de relatie tussen onzekerheid, de investeringspraktijken en de prestaties van de organisatie aan de orde. De prestaties van de organisatie zijn zowel financieel (REV, RTV, "reward-to-variability-ratios") als niet-financieel (effectiviteit, de verhouding tussen een aantal doelstellingen en de werkelijk gerealiseerde resultaten van de organisatie) bepaald. Een correlatie-analyse leert dat de verschillende prestatiemaatstaven (soms sterk) gecorreleerd zijn. Er blijkt geen directe relatie tussen onzekerheid en de prestaties van de organisatie. Drie methoden zijn gehanteerd om de relatie tussen onzekerheid en de prestaties van de organisatie te onderzoeken (interaction approach, matched pairs approach and

the systems approach). Het blijkt dat er geen (statistisch significante) relatie bestaat tussen onzekerheid, (andere contingency factoren,) investeringspraktijken en de prestaties van de organisatie. Er kunnen verschillende redenen zijn voor het feit dat deze relatie niet is aangetroffen; daaronder zijn het gebruik van accounting data (gevoeligheid voor andere verslagleggingssystematiek, gebruik van schattingen, variabiliteit in prestatie maatstaven), het uitsluiten van een aantal andere mogelijk beïnvloedende factoren (financiële structuur, etc.), het gebruik van de "netto rendementen" en het uitsluiten van organisaties die failliet zijn gegaan. Het onderzoeken van voorgaande beperkingen kan verder inzicht in de relatie tussen onzekerheid en investeringspraktijken opleveren.

CHAPTER 1

INTRODUCTION

1.1 The Research Issue

Dealing with uncertainty is an important topic for organizations[1]. This study investigates whether uncertainty has an impact on the design and use of specific elements of the management accounting system. More specifically, the following relations are examined:

- uncertainty and capital budgeting practices;
- other contingencies and capital budgeting practices;
- uncertainty, capital budgeting practices and performance.

The previous terms are discussed in more detail in other sections of this thesis.

The following central theorem is at the core of this thesis:

Does uncertainty (separately or in combination with other contingency factors) affect capital budgeting practices and, if so, does it have an impact on performance?

The links between uncertainty, other contingencies, capital budgeting practices and performance are investigated to explore under what conditions capital budgeting practices differ among organizations and what governs these differences. After reviewing the existing literature on these subjects, the previous theorem is broken down into a number of hypotheses that are tested in the field study part of this research project.

---

[1] The importance of uncertainty to organizations is demonstrated by its position in strategic management, finance and insurance, financial and management accounting and organization literature. Some of this literature, as well as the relevant definitions are discussed in other sections of this thesis. In addition to that, the articles and books mentioned in the list of references at the end of this thesis may provide some additional suggestions on these topics.

The remainder of this chapter is structured as follows. The next section provides the motivation for this thesis. The theoretical and practical relevance of the study is discussed in the third section of this chapter. Section 1.4 provides a discussion on the way the design of this study assists in attributing results. Finally, the structure of the study is described in the last section of this chapter.

1.2 Motivation

The purpose of this study is to develop a better understanding of the way in which uncertainty affects the design and use of elements of the management accounting system, i.e. capital budgeting practices. Prior research in finance, accounting and strategic management literature provides both theoretical as well as (some) empirical support for the separate relations between uncertainty and capital budgeting practices, contingency factors and capital budgeting practices and capital budgeting practices and performance. The literature lacks a coherent theoretical framework on the combined influences of specific uncertainties and other contingency factors on capital budgeting practices.

The study contributes to the literature by integrating the (separate) models from accounting, finance and strategic management literature into a theoretical framework.

The integrative model for the inter-relations among uncertainty, other contingency factors and capital budgeting practices is empirically verified. Considering the number of variables taken into account and the measurement methods used, the model should be regarded as a "first draft" rather than as a "complete model" which fully explains variations in the use of capital budgeting practices among organizations. Future research could verify (or falsify) the relations established in this study.

The next sub-sections elaborate on the motivation by providing an overview of the study and highlighting the way in which the study contributes to the existing literature on finance, strategic management and, last but not least, management accounting.

Management Accounting Systems

It has been suggested that management accounting systems serve three functions (Horngren & Sundem [1990]; Kaplan & Atkinson [1989]):

1. The *decision-making* (or problem solving) function of accounting information is irregular (or non-programmed) rather than regular. It arises when a particular

problem is identified and various alternative courses of action are proposed to handle it (Emmanuel et al [1995]). Accounting information is used to assist in evaluating the economic consequences of the various courses of action proposed. Although routinely collected accounting information may act as a database, the analysis is ad hoc as it is aimed at predicting what the future costs and benefits are likely to be.

2. The *attention-directing* function serves primarily to make a manager aware of a deviation from a previously determined plan. Once the "alarm bell" has been rung, other information is sought in order to decide what action should be taken. Attention directing is commonly associated with current planning and control and with the analysis and investigation of recurring routine internal accounting reports.
3. Finally, the *scorecard* (or performance-evaluation) function of management accounting systems is concerned with monitoring the performance of individual managers or business units. Proper accounting for activities, therefore, calls for the measurement of performance with respect to the goals and objectives of the organization (Ijiri [1975]). It is similar to the attention-directing function, but focuses on the overall performance of the manager or the unit under his command relative to the objectives and targets that have been set.

The same data may serve as a scorecard function for a manager and as an attention-directing function for the manager's superior; the last two functions may therefore be classified under the "decision control" heading. The next sections discuss the implications of these functions for capital budgeting practices.

Capital budgeting practices and decision making

Managers continually allocate resources among competing investment projects in the capital budgeting process. Numerous methods for financial analysis can be used to make the decision to accept or reject the proposed alternatives. There is a large body of survey research in the capital budgeting literature investigating what methods and techniques are used in evaluating and selecting investment projects, both in the Netherlands as well as in other countries (Herst et al [1998]; Slagmulder et al [1995]; Kamath & Oberst [1992]; Klammer et al [1991]; Ho & Pike [1991]). By surveying corporate practices, researchers attempt to address issues such as trends in the application of discounted cash flow techniques or the adoption of uncertainty analysis techniques in capital budgeting. Over the years, surveys have suggested that the use of discounted cash flow techniques (such as Net Present Value and Internal Rate of Return) as primary evaluation techniques has increased (see Segelod [1998]; Pike [1996]). Research findings also suggest that the use of uncertainty analysis in the investment decision has been growing, albeit at a slow rate (see Ho & Pike [1996]; Klammer et al [1991]; Mukherjee & Henderson [1987]).

This study portrays the current state of capital budgeting in the Netherlands, especially with regard to uncertainty identification, analysis and capital budgeting decision rules, and compares the findings with other (contemporary) capital budgeting studies in the Netherlands and other Western countries.

Capital budgeting practices and performance
The relation between capital budgeting practices and performance has been investigated empirically by relatively few authors. The results from this empirical research have been contradictory, which may have been caused by several methodological and practical limitations. The first issue is that researchers have used different definitions for sophisticated capital budgeting practices. Definitions used for capital budgeting practices cover a range from solely capital budgeting decision techniques (Haka et al [1985]) to uncertainty assessment and capital budgeting selection (Ho [1992]) and a capital budgeting system of interrelated components (Kim [1982]; Klammer [1973]). Second, researchers have used different performance measures such as stock prices (Haka et al [1985]), earnings (Ho [1992]), operating cash in relation to end-of-year operating assets (Kim [1982]) and operating rate of return (Chen [1995]; Klammer [1973]). A third issue concerns the empirical design used: some studies have relied on cross-sectional designs (Kim [1982]; Klammer [1973]). Pure cross-sectional design cannot control for many firm- and industry-specific factors (Haka et al [1985]). In sum, previous empirical studies have suffered from theoretical, statistical and data collection problems. The method employed in this study overcomes some of these problems. The empirical research findings in this study do not find a relation between uncertainty, other contingency factors, capital budgeting practices and performance. This is probably due to the large variance in profit, that makes it difficult to single out the impact of one or several related contingency factors (uncertainty).

Contingency Factors
Contingency theory has played an important role in management accounting and strategic management research during the past four decades (Emmanuel, Otley & Merchant [1995]). The contingency approach is based on the premise that there is no universally appropriate "best way" applicable to all organizations in all circumstances. Rather, contingency theory attempts to identify specific aspects of an organization that are associated with certain defined circumstances and to demonstrate an appropriate matching.

Previous empirical research on capital budgeting has mostly documented which capital budgeting decision techniques are used by organizations (Northcott [1992]; Mukherjee & Henderson [1987]). That is, most surveys have portrayed the current position of corporate practices with regard to investment decisions. Only a few

scholars have investigated whether characteristics of either the firm (size, debt ratio, strategy, environmental characteristics, industry) or the investment project (expansion versus replacement projects, new technology investments) are related to capital budgeting practices (Chen [1995]; Slagmulder et al [1995]; Klammer et al [1991]; Haka [1987]; Kim [1982]). Instead of documenting *which techniques are used*, this study also tries to explain *why techniques are used* (i.e., which contingency factors are related to capital budgeting practices). In addition to some of the factors already recognized in previous research (size, uncertainty, industry), some new factors affecting capital budgeting practices (investment strategy, technology, specific uncertainties) have been identified.

Uncertainty and capital budgeting practices

A contingency factor that is investigated in more detail in this study is uncertainty. Uncertainty, risk and exposure[2] have been considered important issues in the literature, equally in finance (Accola [1994]; Williams & Heins [1989]; Conder & Hopkins [1981]; Townsend [1969]; Farrar [1962]), management accounting (Mia & Chenhall [1994]; Simons [1987]; Khandwalla [1972]) and strategic management (Miller [1992]; March & Shapira [1987]; Akerlof [1970]; Knight [1921]; Fayol [1949, 1916]). Relatively little is known on the relation between uncertainty and capital budgeting practices.

Empirical research has indicated that uncertainty tends to influence capital budgeting practices (Kim [1982]; Klammer [1973]). Several variables have been used as general indicators for the degree of uncertainty, including β (Ho & Pike [1992]; Haka et al [1985]), the coefficient of variation of the rate of return on assets (Kim [1982]) and the standard deviation of the rate of return (Klammer [1973]). A disadvantage of such general indicators of uncertainty is that they do not reveal which specific uncertainties have an impact on capital budgeting. For example, the β of a large international chemical firm and a local bank may be similar even though they are influenced by completely different uncertainty factors. Also, previous research has mostly relied on cross tables, correlation analyses or linear regression to investigate the relationship between contingency factors (especially uncertainty) and capital budgeting (see Chen [1995]; Kim [1982]; Klammer [1973]). The joint effects of these variables have hardly been investigated. For example, size may decrease the effects of uncertainty due to increased market power (see Kotler [1988]). This study not only verifies *if* uncertainty has an impact upon capital budgeting practices; it also investigates *what* specific uncertainties influence capital budgeting practices and whether these uncertainties are related to other contingency factors. Rather than

[2] The terms uncertainty, risk and exposure are defined in chapter 2.

calculating an ex post measure of uncertainty, the current study has identified the ex ante determinants of capital budgeting practices.

The combined effects of (specific) uncertainties and other contingencies are synthesized in a multiple contingency framework. The multiple contingency framework provides the opportunity to distinguish among organizations with regard to (specific) uncertainties and other contingency factors. This provides organizations with the opportunity to tailor their capital budgeting practices to the demands of the environment and the organization.

The expected relations between the variables are presented in figure 1.1.

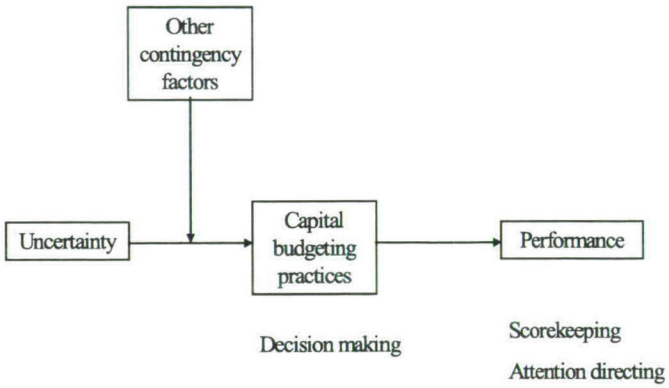

Figure 1.1 *The hypothesized relations between the variables*

1.3 Practical Relevance

While this study has been designed to contribute theoretically to the research literature, it is anticipated that the findings may also be interesting to designers of management control systems (financial directors, management accountants and accounting/finance consultants). The results of the study may also be relevant to senior managers and financial analysts involved in the identification, evaluation, selection and implementation of investment decisions.

The environment in which organizations operate has changed dramatically over the last 30 years, presenting new opportunities and threats to managers (Baril et al [1996]). The breakdown of the Bretton Woods system and the oil crises in the 1970s were followed by deregulation and liberalization of several markets and in-

dustries previously controlled by governments (Grabbe [1991]). In Europe, previously publicly controlled sectors such as postal services, energy, telecommunications, transport and (parts of) social security have been privatized in the 1980s and 1990s. In addition to that, a common market has been established: European countries have abolished internal tariffs and restrictions on factor mobility, use a common external tariff and have fixed exchange rates in transit to one common monetary unit (the Euro). Trade and capital investment restrictions have also been relaxed worldwide, which has resulted in an increase in global (or at least regional) competition.

In addition to that, unpredictable movements in exchange rates, interest rates, and commodity prices nowadays present uncertainties that cannot be ignored. The combination of an increased volatility in exchange rates, interest rates and commodity prices may create stiff competition in the (world) market where none previously existed (Smith et al [1990]). Another change is the increase in (product) liability lawsuits and, as a consequence of that, the increasing costs of liability insurance. Developments in law and legal practices provide plaintiff's new ways to seek compensation for damages brought upon them by other individuals or organizations. Progress in medical and environmental science has identified additional damages that can be attributed to specific organizations. Finally, the discussion about the role of (the board of) large (stock-listed) firms ("corporate governance", see Prahalad [1994]) creates new uncertainties to organizations. The concept of "corporate governance" refers to several interrelated aspects of corporate policy, corporate control, corporate structure, the distribution of income among the companies' different stakeholders and ultimately, the goals of companies. A failure to recognize interest of stakeholders other than shareholders (such as employees, suppliers, customers and the wider community) may result in serious financial consequences.

As a result of these developments, organizations may find themselves in completely new (financial) environments, markets or governance structures. Consequently, their capital budgeting methods may have to be changed to be able to compete with other organizations. The specific uncertainties which may best be addressed by (a change in) capital budgeting practices are identified and analyzed in this study.

The findings of this study offer informed advice and provide some general guidelines for managers on the appropriateness of their capital budgeting practices. One of the challenges facing financial directors, management accounting and finance & accounting consultants is to design management accounting systems (or, in this case, capital budgeting practices) that support decision making. Hopefully, the results of this study will assist in that process.

1.4 The Design of the Study

The field study focuses on the relation between uncertainty, capital budgeting practices and performance of large organizations in the Netherlands. Considering that the finance department is generally involved in the capital budgeting processes of organizations (Northcott [1992], p. 116; Mukherjee & Henderson [1987], p. 81), financial managers of organizations have been the focus of the field study. The research is set in large organizations that have to file their annual reports at the Dutch Chamber of Commerce. Therefore, this field study may include single business enterprises, corporate headquarters of holding companies and independent business units of larger organizations that, by their legal status, are recognized as separate organizations. The potential bias that is due to differences in organizational levels has explicitly been considered in the field study.

To test the theory empirically, the relevant variables have been operationalized. The definitions for the relevant variables are discussed in the next chapter and operationalized in the third chapter. Uncertainty, other contingency factors, capital budgeting practices and performance have been measured at the organizational level relevant to the respondents.

The research project can be classified as (mostly) *explorative research.* An explorative research project is identified by a research procedure where the impact of a number of possibly relevant variables is analyzed; the goal is to find an explanation for one dependent variable (Segers [1980]). One additional characteristic of explorative research is the stepwise selection and combination of the identified variables. Within this research project, the capital budgeting practices of an organization are defined as the dependent variable. Independent variables include uncertainty factors and other contingencies such as objectives, strategy, size and technology. The identified variables are based on literature research and are verified empirically. The explorative nature of the study results in the inclusion of as many (potential) determinants of capital budgeting practices in the model as possible; additional research may reveal whether these variables are rightfully included. The research has been carried out in a project structure: the intended research activities have been completed in several steps, each with its own time schedule.

1.5 The Outline of the Study

The outline of the study is presented in figure 1.2.

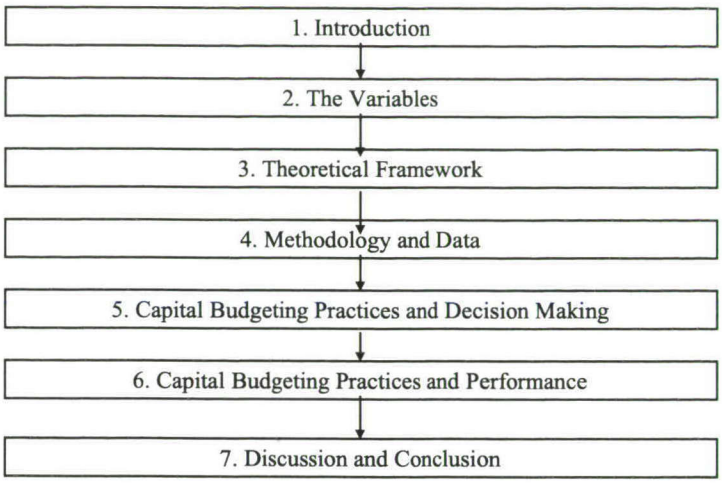

Figure 1.2 *Outline of the study*

In the next chapter, the variables of interest in this study are defined. Chapter 3 develops the theoretical model, leading to a formal statement of hypotheses to be examined. In chapter 4, the methodologies and data collection procedures used to conduct the study are introduced. Chapter 5 presents the results on capital budgeting practices and decision making, while chapter 6 provides the results on capital budgeting practices and performance. Finally, the theoretical and empirical findings are discussed in chapter 7; this chapter also presents some possibilities for future research and summarizes the most important conclusions.

CHAPTER 2

THE VARIABLES

2.1 Introduction

In this chapter, the variables of interest for this study are defined. The next section deals with the definition of a management accounting system. The elements of the management accounting system that are investigated in more detail, i.e. the capital budgeting practices, are discussed in section 2.3. Section 2.4 defines contingency factors. Next, section 2.5 deals with the contingency factor under consideration, i.e., uncertainty, as well as with related terms such as risk and exposure. In section 2.6, performance measurement is defined. The last section summarizes the chapter.

2.2 Management Accounting Systems

Management accounting systems provide information to assist managers in their planning and control activities. Management accounting activities include identifying, collecting, classifying, processing, analyzing, and reporting information to managers. Many definitions of management accounting have been proposed (Drury [1996]; Horngren & Sundem [1990]; Kaplan & Atkinson [1989]; Lee [1987]; Amigoni [1978]). In general, these definitions have several common elements, which can be summarized as follows:

1. Management accounting involves the provision of information (either financial or non-financial);
2. Management accounting facilitates decision making within the organization;
3. Management accounting motivates and assists in achieving the overall goals or objectives of the organization.

Each of these elements will be discussed shortly.

Provision of information

Conventionally, the design of (management) accounting systems was confined to recording, classifying and summarizing financial information internal to the organization with a historic orientation (Kaplan & Atkinson [1989]; Ijiri [1975]). In time, it has been acknowledged that the scope of management accounting extends beyond traditional measures of costs and revenues from transactions that have already occurred. The management accounting system can use non-financial data focusing on marketing concerns, product innovation, strategic planning and predic-

tive information related to these decision areas. Also, opportunity costs from transactions not taken and extensive performance measures based on physical or non-financial measures may be included. This broader definition of management accounting systems (i.e., including non-financial and external data) is used within the context of this thesis.

Facilitating decision making within the organization

Ijiri [1975] notes a substantial shift from the processes internal to accounting (recording, classifying and summarizing) towards the processes external to accounting (economic decision-making). The accounting literature until about 1960 has been dominated by the need for an adequate set of standards, principles, definitions, or other guides to data collection. On the other hand, the user decision model approach is more user-oriented; this approach has dominated accounting literature since the 1960s (see Kaplan [1984]; Ijiri [1975]).

A third model, the information evaluation approach, treats accountants as decision-makers whose task is to choose one of many alternative accounting methods in such a way that the choice will lead to an optimum result. Within this study, a user-decision-oriented approach is used: it is assumed that organizations select those capital budgeting practices that help them realize their goals. This does not exclude the fact that the results of this thesis may be helpful for accountants and consultants that try to select capital budgeting practices that lead to an optimal result within their organization (the information evaluation approach).

Achieving goals/objectives

Management accounting systems are supposed to motivate and assist managers in attaining organizational objectives in a timely, efficient, and effective manner. An organization can have numerous goals and objectives, including survival, profit maximization, shareholder value, sales growth, quality, innovation and social responsibility (see Emmanuel et al [1995]; Kaplan & Norton [1992]). As organizational objectives are multiple, partially conflicting and subject to change over time, appropriate measures of performance will have similar characteristics. The goals and objectives of organizations and their interrelations with capital budgeting practices are explicitly considered in this study.

This study focuses on a specific aspect of the (management) accounting system: capital budgeting practices. Although previous elements refer to management accounting systems in general, they are also applicable to capital budgeting practices in particular. The next sections of this thesis discuss capital budgeting practices in more detail.

2.3 Capital Budgeting Practices

One of the most important strategic decisions for an organization is how much to invest in specific assets, and when to invest. This decision is the investment, or capital budgeting, decision. Capital budgeting involves the entire process of planning expenditures, which are expected to extend beyond one year. By means of capital budgeting decisions, the organization's strategy evolves and is implemented (Emmanuel et al [1995], p. 319).

Capital budgeting practices can be defined as the procedures, routines, methods and techniques used to identify investment opportunities, to develop initial ideas into specific investment proposals, to evaluate and select a project and to control the investment project to assess forecast accuracy (Segelod [1997]; Mukherjee & Henderson [1987]). For the purposes of this study, a restrictive meaning is given to capital budgeting practices. Attention is directed primarily to those steps that lend themselves to generalization and that may be compared to previous research projects. For that reason, the selection phase is investigated in more detail while the project identification, development and control phase are not specifically under consideration in this study.

2.3.1 Capital Budgeting Practices and Decision Making

The investment decision implies a commitment into the future, often in the face of considerable uncertainties. What makes the capital budgeting decision so demanding is not the problem of projecting return on investment under any given set of assumptions. The difficulty is in the assumptions and their impact. Each assumption involves its own degree -often a high degree- of uncertainty; and, taken together, these combined uncertainties can multiply into an uncertainty of critical proportions. This is where uncertainty enters into the capital budgeting decision (Hertz [1964], p. 95).

The effective handling of uncertainty is an important, often complex, task in analyzing capital budgeting decisions. Major fluctuations in exchange rates, increasing rates of technological change and less predictability in competitor behavior have made the uncertainty problems in capital budgeting decisions more acute in recent years.

Topics of interest in the capital budgeting decision-making process include (Northcott [1992]):

- Recognition of potential investments;
- The preselection classification of projects and any impact of classification on selection;
- Personnel (or departments) with selection authority;

- Techniques of analysis;
- Methods of uncertainty assessment;
- The extent of capital rationing, its origin, and its impact on project analysis;
- The use of cost of capital measures, and;
- The personnel with authority to approve capital investments.

Analysis techniques and methods of uncertainty assessment have been investigated most thoroughly in other research projects (Mukherjee & Henderson [1987]). The focus of this research project is on the following elements of the capital budgeting decision-making process:

- *Identification of uncertainty* refers to the processes by which organizations systematically and continuously identify the uncertainties that (may) have an impact on their investment projects;
- *Analysis of uncertainty* refers to the methods and procedures available to help managers understand the uncertainties associated with a project;
- *Adjustments for uncertainty* refer to the alternative methods available to adjust the project under consideration for the (costs of) uncertainty associated with it;
- *Capital budgeting selection rules* refer to the capital budgeting decision criteria used by organizations to select investment projects.

This research project concentrates on the uncertainties that influence capital budgeting decisions; it is expected that the uncertainties have the largest effect on the four sub-steps mentioned previously (identification, analysis, and adjustment for uncertainty and project selection). It is argued that investment decisions of organizations should be based on a thorough identification and assessment of uncertainties, as well as on a decision rule that accounts for uncertainty.

2.3.2 *Capital Budgeting Practices and Performance*

Capital budgeting expenditure is difficult to control because each investment is usually unique, and therefore no predetermined standards or past experience will be available for establishing what the performance should be. When the investment is in operation, the actual results should be compared with the estimated results that were included in the investment proposal. Except for the very large projects, the performance that stems from a specific capital investment is generally difficult to isolate.

Although the results of individual projects are hard to evaluate, it is possible to examine the combined effects of several selected investment projects. That is, it is possible to regard an organization (or an organizational unit) as a combination of selected individual investment projects (see Salamon [1982]; Ball & Brown [1977]). In that case, the performance of the organization (or organizational unit) has to be known.

This "combination method" is used within this thesis: performance is measured at the level of the organization surveyed in this research project. This approach has also been used in other studies (Ho [1992]; Ho & Pike [1992]; Haka et al [1985]; Kim [1982]; Klammer [1973]).

2.4 Contingency Factors

The study of the impact of the environment on the organizations has undergone a major change in the thrust of organizational research in the early 1960s (see Emmanuel et al [1995]; Dessler [1986]). Whereas nearly all previous work had been universalistic in approach, seeking the one best organizational solution, much of the work conducted from the early 1960s on noted that particular forms of organization were best suited to particular environmental conditions. This observation laid the foundation for the development of contingency theories. The contingency approach is of considerable importance for (management) accounting researchers, since it has dominated behavioral accounting research during the last 30 years. The contingency approach to management accounting is based on the premise that there is no universally appropriate accounting system applicable to all organizations in all circumstances. Contingency theory attempts to identify specific aspects of an accounting system that are associated with certain defined circumstances and to demonstrate an appropriate matching (Otley [1980]).

Three major classes of contingent factors have been defined: the environment, organizational structure, and technology (Emmanuel et al [1995]). Relevant features of an organization's environment affecting accounting system design that have been suggested include the degree of predictability, the degree of competition in the market place, the number of different product-markets faced, and the degree of hostility exhibited. Structural features include size, interdependence, decentralization and resource availability. Technological factors include the nature of the production process, its degree of routineness, how well means-end relationships are understood and the amount of task variety. For the purposes of this research project, a contingency factor is any factor that affects accounting system design (more specifically in this study, capital budgeting practices).

2.5 Uncertainty

The contingent variable of specific interest in this study is uncertainty. Uncertainty, risk and exposure are three related terms that are sometimes differentiated and sometimes used synonymously in finance, accounting and strategic management literature (Miller [1992]). Knight [1921] is generally credited for introducing the technical distinction between risk and uncertainty. In Knight's [1921] essay "Risk, Uncertainty and Profit" it is stated that uncertainty arises out of partial knowledge: uncertainty is the condition under which no numerical probabilities can be attached to the various alternative outcomes. According to Knight, uncertainty can stem from basically two sources. First, all the states of the world may be known, but it is impossible to assign probabilities to these states (see, for example, the "lemons" models from Akerlof [1970]). Second, neither the states of the world nor the corresponding probabilities are (all) known (Langlois & Cosgel [1993], p. 459). In addition to that, Knight ([1921], p. 20, p. 225) defines risk as "*measurable* uncertainty", i.e., an "empirical evaluation of the frequency of association between predicates, not analyzable into varying combinations of equally probable alternatives". Thus, Knight defines risk as the condition under which numerical probabilities can be attached to the various alternative outcomes. Finally, exposure is a term that refers to the sensitivity of an organization or project's cash flows (or other target variables) to changes in any of a number of interrelated uncertain variables (Smith et al [1990]; Austen & Reyniers [1986]).

The term "uncertainty" is used in the remainder of this study because most business decisions may be classified as decisions under uncertainty (Ijiri [1975]). The future state of the environment is not known to the decision-maker at the time of the decision. Based on his past experience, he can only estimate the likelihood of each of the states of the environment occurring. Also, the payoff matrix itself is not known with certainty: he can only estimate what its components are likely to be. Even if there is information available on the distribution of specific variables (interest rates, exchange rates, etc.) or on the relation between the specific variables (interest rates, exchange rates) and the target variable (profit, cash flows) of the organization, it is quite unlikely that all interrelations are known. For example, Ho & Pike ([1996]) found in a survey on the application of uncertainty analysis tools in capital budgeting practices that firms barely had information on macroeconomic factors, competitor reactions, technological trends, political climate and public opinion. Thus, most capital budgeting decisions may be regarded as decisions under uncertainty.

Several researchers have developed instruments to measure uncertainty (Miles & Snow [1978]; Duncan [1972]; Khandwalla [1972]; Lawrence & Lorsch [1967]). Among other things, these instruments have been used to investigate the impact of uncertainty on (elements of) management accounting systems (Chen [1995]; Govindarajan [1984]; Khandwalla [1972]). However, these uncertainty measures are generally designed to measure the uncertainty in the environment of the organization; uncertainties within the organization (such as behavioral uncertainties, R&D uncertainties, and credit uncertainties) are not addressed by these instruments. Therefore, another uncertainty measure that covers both internal and external categories of uncertainty had to be used.

The categorization of uncertainties has received considerable attention in literature. Among the uncertainty categorizations are:

- Business versus project uncertainties (Townsend [1969]);
- Business versus financial uncertainties (Baril et al [1996]);
- Direct versus indirect uncertainties (Pringle & Connolly [1993]);
- Market versus company uncertainties (Seidler & Carmichael [1981]);
- Dynamic versus static uncertainties (Fanning [1983]);
- Strategic, operational and financial uncertainties (Vojta [1992]);
- General, industry and firm uncertainties (Miller [1992]).

Based on an analysis of these categorizations, the framework developed by Miller [1992] has been selected for the purposes of this research project. Miller's categorization covers most of the uncertainties described by other researchers. For example, Lawrence & Lorsch's [1967] instrument is a nine-item questionnaire designed to measure uncertainty in the three sub-environments of marketing, manufacturing and research; Miller's framework includes questions regarding R&D uncertainties and manufacturing uncertainties. Miles & Snow [1978] use questions on suppliers, competitors, customers, financial/capital markets, government and labor unions to produce an overall perceived environmental uncertainty score; Miller's framework also captures these elements. Finally, Duncan's [1972] dimensions (complexity and dynamism) have been included as a single-item question.

2.6 Performance Measurement

Previously, it has been argued that management accounting systems serve two functions: accounting for decision making and accounting for control (see section 1.2). The focus in empirical research on capital budgeting research has mainly been on capital budgeting decision making (see Northcott [1992]; Mukherjee & Henderson [1987]). In this study, accounting for control (scorekeeping, attention directing) in

capital budgeting practices is also addressed: do organizations that achieve an "appropriate match" between uncertainty (other contingency factors) and capital budgeting practices achieve a better performance?

Implicit in accountability are the goals to be achieved. Proper accounting for activities, therefore, calls for the measurement of performance with respect to these goals (Ijiri [1975]). Performance measurement may be defined with respect to many kinds of goals, such as economic, social or engineering goals. However, the goals that are most commonly observed in accounting and finance are economic goals. Performance measurement may be characterized as primarily economic performance measurement, although some authors have argued that goals in other fields (quality, R&D) should also be included (Kaplan & Norton [1992]). The goals and objectives of organizations are explicitly considered in this research project.

Previous research has provided some insight into the relationship between performance and capital budgeting practices. In general, most hypotheses in previous research projects have stated that the performance of an organization would improve following the adoption of advanced capital budgeting practices. The majority of previous research projects has found no significant relationship between capital budgeting practices and firm performance. This may be due to several reasons, including the variance in profit (sum of the variances in revenues and costs), the definition of capital budgeting practices, the selection of matched pairs and the definition of the performance measures.

Preceding research projects have generally relied on ex post financial performance measures such as earnings per share (Kim [1982]), the rate of return (Chen [1995]; Ho [1992]; Klammer [1972]), the level of capital investment (Ho & Pike [1992]) or stock performance (Haka [1987]). Four objective financial performance measures (return on assets, ROA, and return on equity, ROE; and their uncertainty adjusted equivalents, the $RTVR_{ROA}$ and $RTVR_{ROE}$) and one subjective performance measure (effectiveness) have been chosen for the purposes of this research project. The reason for the inclusion of effectiveness is that some performance dimensions critical to long term success of investment projects in uncertain situations (R&D, ethical performance, political/public effects) may not be amendable to objective, quantitative measurement. Therefore, the financial, objective and ex post performance measures (ROE and ROA) are supplemented by a more or less ex ante, non-financial and subjective performance measure (the effectiveness measure). The definition and calculation of these performance measures is discussed in chapter 4 of this thesis.

2.7 Summary

This chapter has provided the variables of interest for this study: management accounting systems, capital budgeting practices, uncertainty, other contingency factors and performance. The management accounting system is identified as the system that provides financial and non-financial information for decision-making to achieve the goals of the organization.

Capital budgeting practices are defined as the procedures, routines, methods and techniques used to identify investment opportunities, to develop initial ideas into specific investment proposals, to evaluate and select a project and to control the investment project.

Since the 1960s, it has been noted that there is no universally appropriate accounting system applicable to all organizations in all circumstances. Contingency theory attempts to identify specific aspects of an accounting system (for example, capital budgeting practices) that are associated with certain defined circumstances (contingent variables) and to demonstrate an appropriate matching (using a performance measure; see Otley [1980]). The contingent variable of major interest in this study is uncertainty. Five performance measures (four financial, objective and ex post: ROA and ROE, and their uncertainty-adjusted equivalents, the Reward-to-Variability-Ratios, RTVR, for ROA and ROE; and one non-financial, subjective and ex ante performance measure: effectiveness) are used to investigate whether an appropriate matching between uncertainty and capital budgeting practices results in a higher performance.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1 Introduction

This study examines the effect of uncertainty on capital budgeting practices. It is an endeavor to build on earlier findings examining the factors influencing capital budgeting practices (see Slagmulder [1997]; Chen [1995]; Ho & Pike [1992]; Klammer et al [1991]; Haka [1987]; Kim [1982]; Scapens & Sale [1981]; Schall & Sundem [1980]). The factor of main interest in this study is uncertainty. Uncertainty is assumed to influence capital budgeting practices in basically two ways. First of all, it is argued that organizations implement procedures and guidelines that require a systematic identification and analysis of uncertainties to ensure that uncertainty is accounted for in capital budgeting decisions as uncertainty increases. In this sense, capital budgeting practices may be regarded as an uncertainty management tool: by identifying and pricing uncertainty, organizations seek to balance (the costs of) uncertainty and profit. Second, uncertainty has an indirect effect on capital budgeting practices through a composite set of organizational structures and processes. In this sense, capital budgeting practices are one element of the governance system of the organization. Each of these effects is investigated in this study. Capital budgeting practices may be regarded as a part of the most feasible set of organizational structures and processes that determine the (investment) effectiveness of the organization. Each of these possibilities is investigated in more detail in this thesis.

This chapter is structured as follows. Section 3.2 describes the capital budgeting practices considered in this study and describes the major trends highlighted in other research projects. Section 3.3 describes how uncertainty is expected to affect capital budgeting practices. Section 3.4 describes what other contingency factors may have an impact on capital budgeting practices and how they interfere with capital budgeting practices. Each of these sections is concluded with the hypotheses drawn from theory. In section 3.5, the expected relations between uncertainty, capital budgeting practices and performance are presented. Finally, section 3.6 summarizes the theory and hypotheses presented in this chapter.

3.2 Capital Budgeting Practices

As mentioned in the previous chapter, capital budgeting practices refer to the procedures, routines, methods and techniques used to make and control investment decisions. Also, the focus of this study is on the identification and analysis of uncertainty, the uncertainty adjustments made in projects and the capital budgeting selection rules used by organizations. Each of these elements is discussed shortly.

Identification of Uncertainty

Any serious attempt to manage uncertainty begins - consciously or unconsciously - with the identification of the uncertainties relevant to the organization (or the investment project). Organizations that do the best job in uncertainty identification use a conscious, organized approach to the task. In uncertainty management literature, there are several methods that have been suggested for the identification of uncertainties (Williams & Heins [1989], p. 56; Conder & Hopkins [1981], p. 6):

- *Checklists of potential losses:* these may provide an overview of the uncertainties that may have an impact upon (the future assets of) the organization.
- *Financial statement method:* The financial statement method relies on an analysis of the (projected) financial records of an organization or a project. By analyzing the (projected) balance sheet and operating statements, management can identify all the uncertainties of a project since every business transaction ultimately involves either money or property.
- *Flow-chart method*: A (series of) flow chart(s) is constructed to show all the (future) operations of the investment project. The flow chart starts with raw materials, power and other inputs at suppliers' locations and ends with finished products in the hands of customers. Next, a checklist of potential losses is applied to each property and operation shown in the flow chart to determine the uncertainties relevant to the organization.
- *On-site inspections*: Management can learn about the potential losses for the organization by observing firsthand the (other) organization's facilities and the operations conducted therein.
- *Interactions with other organizational units*: A fifth way to identify uncertainties is through systematic and continuous interactions with other departments in the organization (such as engineering, production or marketing).
- *Interactions with outsiders*: In addition to communicating with other organizational units, management can interact with outsiders rendering related services to the firm to identify the uncertainties relevant to the organization (for example accountants, lawyers or bankers).

- *Contract analysis*: Management can determine whether the organization has increased or reduced its uncertainties under a contract.
- *Statistical records*: Statistical records may contain information on losses or near losses in the past that may repeat themselves in the future. Analysis of statistical records of losses will probably suggest fewer uncertainties, but may identify uncertainties not discovered by other methods.
- *Analysis of the environment*: A careful analysis of the environment (both external and internal) has been suggested as an approach to identify the uncertainties of a particular organization (Liberatore et al [1992]).

Analysis of Uncertainty

There are a number of procedures that have been developed to help the manager understand the effects of uncertainty on the target variable of a project (Northcott [1992]; Shapiro [1989]; Brealey & Myers [1988]; Weston & Copeland [1986]):

- *Sensitivity Analysis*: Sensitivity analysis is a what-if technique that measures how the expected values in a decision model will be affected by changes in the critical data inputs. The input factors that have a significant impact on the capital budgeting decision outcome are identified by recalculating the NPV or profits of a project, changing only one key variable at a time so that its effect on the project's NPV or profit can be determined. Drawbacks to sensitivity analysis are that it always gives somewhat ambiguous results and that the underlying variables are likely to be interrelated. A special case of sensitivity analysis is *Break-even Analysis*. In a break-even analysis, the relations between the size of investment outlays and the required volume to achieve profitability are investigated. A break-even analysis is a device for determining the point at which the NPV or profit of a project is equal to zero. Breakeven analysis is useful in studying the relations among volume, prices, and costs, but has limitations with regard to the sales possibilities of the firm, the constant costs of the firm and the quantity and quality of the products sold by the firm.
- *Scenario analysis*: Sensitivity analysis allows you to consider the effect of changing one variable at a time. By looking at the project under alternative scenarios, you can consider the effect of a limited number of plausible combinations of variables. Scenario analysis is informal in the sense that no probabilities are attached to the likelihood of various outcomes.
- *Monte Carlo Simulation*: Monte Carlo simulation is a tool for considering all possible combinations of variables in a project. It provides the opportunity to inspect the entire distribution of project outcomes (Hertz [1968], p. 98). Monte Carlo simulation represents a refinement over sensitivity analysis and scenario analysis in that it does employ probability estimates.

- *Decision Trees*: Most important decisions are not made once and for all at one point in time; rather, decisions are made in stages. In a decision tree, the sequence of events is mapped out like the branches of a tree; it is helpful for analyzing projects involving sequential decisions. By displaying the links between today and tomorrow's decisions, they help to find the most rewarding strategy.
- *CAPM-/β-analysis*: Modern portfolio theory has provided an approach to determine a project's required rate of return that does take uncertainty in account. The securities market line (SML) provides the uncertainty-return relationship. An uncertainty-free investment carries a basic uncertainty-free rate of return (R_f), and all investments with higher uncertainty carry an uncertainty premium. In using the SML, the "degree of uncertainty" of a project and the corresponding required rate of return need to be determined.

Adjustments for Uncertainty in Capital Budgeting

All else being equal, firms prefer to invest in projects that have relatively stable profits or cash flows and minimal uncertainties. But all is not equal, so firms devote resources to evaluate the consequences of uncertainties for the attractiveness of potential investment projects. Economists have outlined several approaches to deal with the problems raised by uncertainty. Most approaches presume that certainty is preferred to uncertainty. Shapiro ([1989], p. 564) recognizes five alternative methods that account for uncertainty in projects:

- *Adjusting the Discount Rate or Payback Period*: The uncertainties relevant to a project are usually described in general terms instead of being related to their impact on specific elements of the investment project. This rather vague view of uncertainty probably explains the prevalence among companies of two unsystematic approaches to account for uncertainty within the investment project. One is to use a higher discount rate for uncertain projects, another is to require a shorter payback period. Neither of the aforementioned approaches lends itself to a careful evaluation of the actual impact of a particular uncertainty on investment returns. Using a uniformly higher discount rate just distorts the meaning of the present value of a project by penalizing future cash flows more heavily than current ones, without obviating the necessity for a careful evaluation of the relevant uncertainties. Furthermore, the adjustment of the discount rate or payback period is often an arbitrary one.
- *Risk Absorption*: Risk absorption adjusts cash flows by charging a premium for insurance to each year's cash flows or income streams, whether or not such an insurance is actually purchased[3]. This solution, however, does not really measure all

[3] This approach is suggested by Arthur Stonehill and Leonard Nathanson, Capital Budgeting and the Multinational Corporation, California Management Review, Summer 1968, p. 39-54.

effects of the uncertainties on the *economic value* of the project. Several insurance premiums only cover the book value and not the economic value, and the relation between the book value of a project's assets and the economic value of a project as measured by its future cash flows is tenuous at best.

- *Adjusting Expected Values*: Another approach is to adjust the cash flows or income streams of a project to reflect the specific impact of specific uncertainties. Generally, there is more and better information on the specific impact of given uncertainties on a project's cash flows than on its required return.
- *Using Certainty Equivalents*: Under this approach, the cash flow or income elements are adjusted to reflect the uncertainty behind their estimation, producing "certainty equivalent" values[4]. Uncertain cash flow or income elements are transformed into certain cash flows or income elements by using an uncertainty-certainty transformation function[5]. The "translated" certain cash flow elements are then used in the remainder of the capital budgeting process (for example, discounted at the uncertainty free rate to calculate the NPV of the project). The advantage of this certainty equivalent method is that it applies an individual approach to different cash flow or income elements, taking their individual uncertainty into account. Up until now, however, no satisfactory method has yet been developed to generate certainty-equivalent cash flows or income streams. Furthermore, it involves losing some information on the valuation of future cash flows that is provided by shareholders in the form of their required yield on a typical firm investment.

Investment Project Selection

The next step in the investment process involves the selection of investment projects. In order to come to a decision in the investment selection process, a capital budgeting decision criterion is needed. Among the capital budgeting selection criteria used are (see Dixit & Pindyck [1994], p. 135-212; Brealey & Myers [1988], p. 71-88; Weston & Copeland [1986], p. 99-132; Bierman & Smidt [1984], p. 28-45):

- *Accounting Decision Rules*: Accounting decision rules are based on accounting income, not cash flows from a project. These decision rules are based upon projected income statements and balance sheets; therefore, they do not take the time value of money into account. Accounting decision rules include the payback period and the accounting rate of return.

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4 For a more elaborate discussion of the certainty equivalence theory, see Brealey & Myers [1988], p. 191-199; Copeland & Weston [1988], p. 202-205; Farrar [1962], p. 11-16; Townsend [1969], p.85-88.

5 The certainty-equivalent value of any combination of expected value and uncertainty can be expressed by the following transformation function (see Townsend [1969], p. 86; Farrar [1962], p. 12):
U = f(E,V), where: U = utility; E = expected value; and V = variance.

- *Discounted Cash Flow Decision Rules*: Discounted cash flow (DCF) decision rules take account of the time value of money. DCF-decision rules include the Internal Rate of Return (IRR), the Profitability index (PI) and the Net Present Value (NPV). Fairly recently, *Real Option Pricing Theory (ROPT)* has been introduced as a technique that allows for flexibility when evaluating an investment opportunity (Lint & Pennings [1997]). It is actually an extension of the NPV-analysis. The ROPT captures two aspects of extra or economic desirability that are inadequately captured by a standard NPV analysis (Trigeorgis and Mason [1987], p. 14). The first aspect is operating flexibility (which enables management to make or revise decisions at a future time, such as expansion or abandonment of the project), the second is the strategic option value (resulting from interdependence with future and follow-up investments, such as implementation in phases and postponement of investments).
- *Game Theory Decision Rules*: Game theory is useful where probability estimates cannot easily be arrived at. Simple game theory takes a conservative approach, aiming to minimize the loss or "regret" from making a bad capital budgeting decision. Therefore, this approach may not produce the "best" investment decision but offers ways of eliminating what may be perceived as the most uncertain option (Lint & Pennings [1998]; Bouma [1982]; Luce & Raiffa [1957]). A number of criteria have been offered to resolve such the decision problem under uncertainty; among them are the maximal criterion, the maximum criterion, the minimal regret criterion, the pessimism-optimism index criterion of Hurwicz and the criterion based on the "principle of insufficient reason".

Much of the investigation of capital budgeting practices has concentrated on the extent to which DCF methods and methods for uncertainty analysis have been adopted in practice (Herst et al [1998]; Slagmulder et al [1995]; Wilner et al [1992]). Previous surveys have shown that DCF analysis is becoming a standard practice (at least in the US and the UK). Most firms seem to use non-DCF techniques as additional forms of analysis; the most frequently used are payback period and accounting rate of return. Therefore, organizations employ a combination of appraisal methods rather than rely upon a single technique. Also, the proportion of organizations using uncertainty analysis seems to have increased over time. The more popular uncertainty adjustment techniques are applying adjusted discount rates and adjusting the required payback period. Finally, little is known about the (systematic) identification of uncertainty in the capital budgeting decision. This study seeks to provide some insight in this issue.

The first purpose of this study is to update information about the capital budgeting practices implemented by large organizations in the Netherlands and to compare the current results with previous studies. It is expected that the previous trends

(high "application rates" of DCF-methods, an increase in the application of uncertainty analysis methods, combination of appraisal methods) are also observed in the Netherlands. In addition to that, it is expected that the "application rates" of the different methods and techniques in the Netherlands are similar to those in other Western countries. This results in the following hypothesis:

Hypothesis 1:
The trends observed in other Western countries regarding capital budgeting practices (high "application rate" of DCF-methods, an increase in the application of uncertainty analysis, combination of appraisal methods) are also observed in the Netherlands.

Hypothesis 2:
The "application rates" of the different methods and techniques in capital budgeting practices in the Netherlands are similar to those in other Western countries (US, UK, European Union).

Sophistication of capital budgeting practices

Generally, most of the capital budgeting survey literature has documented "which" capital budgeting practices are used in stead of explaining "why" they are used. Most surveys portray the current position of organizational practices regarding capital budgeting, some in specific countries (Pike [1996]), industries (Kamath & Oberst [1992]) or segments of the economy (Block [1997]). In this study, the relation between uncertainty and (the sophistication of) capital budgeting practices is investigated. For the purposes of this study, capital budgeting practices are divided into the following groups:

- *Naive selection techniques (SRA):* Naive selection techniques generally do not use all available information with regard to net cash flows or income, do not consider present values and/or do not incorporate uncertainty in a systematic manner. They are generally based on deterministic estimation and intuitive adjustments for uncertainty in the investment project (if adjustments for uncertainty occur at all). Pike & Ho [1991] refer to these techniques as *Simple Risk/Uncertainty Adjustment (SRA)* methods.
- *Sophisticated selection techniques (ARA):* Sophisticated selection techniques are those that deal with uncertainty in a project; uncertainty, cash flows and the time value of money are identified and evaluated in a systematic way. These techniques are based on a comprehensive awareness of the uncertainties associated with various critical variables. This study refers to these techniques as *Advanced Risk/Uncertainty Adjustment (ARA)* methods. The ARA-methods can be split into two basic categories:

- *Probabilistic Risk/Uncertainty Analysis (PRA)*: PRA-techniques usually involve the evaluation of the variances and the expected value of a project's outcomes. Commonly employed PRA techniques include basic probability analysis (including sensitivity analysis), decision tree analysis and Monte Carlo simulation. Organizations that qualify as PRA-user identify and analyze uncertainties, make adjustments for them and base their decision on a DCF-method in a structural and systematic manner.
- *Game/Option Theory Analysis (GOTA)*: in addition to providing probability distributions for a number of underlying variables, organizations may also use game theory and real option pricing theory (ROPT) to analyze and make investment decisions. This includes the investigation of the nonquantifiable benefits of an investment project (Lint & Pennings [1997; 1998]; Accola [1994]; Liberatore et al [1992]; Kaplan [1986]). Nonquantifiable benefits include increased market demand due to improved process control/product reliability, improved product performance, additional manufacturing capabilities/flexibility, inventory savings, less floor space, higher quality, rapid learning effects, and improved employee morale. Commonly employed GOTA techniques include subjective ranking of uncertain benefits, ROPT-analyses and game theory decision rules.

Within this study, the terms "advanced capital budgeting practices" and "sophisticated capital budgeting practices" are used intermittently. It is noticeable that these terms may differ from terms in other research studies (for example, Ho & Pike [1992]; Haka et al [1985]; Schall & Sundem [1980]). In this study, the mere application of DCF-techniques is not sufficient to qualify as "sophisticated"; rather, the application of a structured approach to uncertainty is the relevant criterion.

3.3 Uncertainty

Uncertainty and Capital Budgeting Practices

This study examines the relations between specific uncertainties and the capital budgeting practices used in organizations, with a goal of further developing a descriptive model of capital budgeting practices. Therefore, uncertainty is the (most important) contingent variable hypothesized to influence capital budgeting practices in this study.

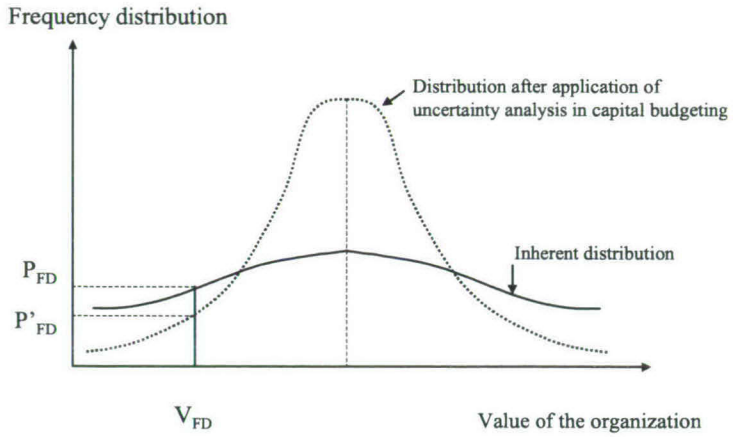
Several researchers have tried to identify the nature of the relation between uncertainty and the capital budgeting practices of organizations. The results on this relation are often contradictionary. For example, Kim [1982], Schall & Sundem [1980] and Klammer [1973] all found that uncertainty seems to be related to the

application of the payback criterion in capital budgeting practices. In addition to that, they all found that the use of DCF-techniques seems to decrease in highly uncertain environments. This result was contrary to what Schall & Sundem [1980] expected: they hypothesized that firms in uncertain environments used more sophisticated capital budgeting practices (i.e., DCF-techniques). Haka [1987] provided an explanation for this observation: she hypothesized that DCF-techniques become less useful for decision making when it is impossible to obtain good estimates for the parameters required for DCF-decisions. In addition to that, Haka found that predictable environments resulted in a higher application of DCF-techniques and a higher performance. However, Haka's results have been contradicted by results from Chen [1995], who found that higher environmental uncertainty resulted in higher application rates for DCF-techniques. Therefore, the nature of the relation between uncertainty and capital budgeting practices is still unclear.

Galbraith [1973] provides the basis for the hypothesis in this study that an increase in uncertainty is positively related to the application of advanced capital budgeting practices. Galbraith [1973] argues that organizations can deal with uncertainty by reducing the amount of information required for decision making, or by increasing the organization's information processing capabilities. The application of advanced capital budgeting practices may be regarded as an increase in the information processing capabilities of the organization. The application of advanced capital budgeting practices is not a cost free process: both time and effort must be expended (see Ho & Pike [1996]; Klammer et al [1991]). The increase in capital budgeting costs may result from the attraction of qualified personnel, the purchase of advanced computer programs and the acquisition of information.

There are also costs associated with financial distress, such as costs of increasing interest rates and equity costs, increasing demands from suppliers and customers, increasing turnover of personnel, costs of lawyers, official receivers and bankruptcy court, etc (Shapiro & Titman [1982]). If it is assumed that the costs of financial distress are equal to all organizations, the *expected* costs of financial distress are higher for "high uncertainty organizations".

Organizations seek to reduce the chance of encountering financial distress by reducing the variance in the distribution of the performance of the organization (see figure 3.1). The adoption of advanced capital budgeting practices may be regarded as one way to reduce the variance in the performance of the organization.



Define V_{FD} as that value of the organization below which financial distress is encountered. It is assumed that the application of uncertainty analysis in capital budgeting reduces the probability of V_{FD} from P_{FD} to P'_{FD}.

Figure 3.1: *Impact of uncertainty analysis in capital budgeting on probability of financial distress*[6]

The application of advanced capital budgeting practices becomes, in essence, an application of the classic proposition of the economic theory for organizations: the organization should operate at the point where its marginal revenue is just equal to its marginal cost. When this rule is applied to the decision to apply advanced capital budgeting practices, marginal revenue is taken to be the reduced chance of financial distress. Marginal cost is related to the costs of the acquisition of additional information processing capabilities. The adoption of more advanced capital budgeting practices may be regarded as just another economic decision made by organizations: the benefits (from a reduction of the costs of uncertainty) must supersede the costs (from the adoption of more advanced capital budgeting methods).

Considering that the expected costs of uncertainty are higher for "high uncertainty organizations", it is expected that they will adopt advanced capital budgeting practices earlier than "low uncertainty organizations" (under the assumption that the costs of advanced capital budgeting practices are similar to both categories of organizations).

6 Adapted from Smith et al [1990], p. 368.

Uncertainty Framework

For the purpose of this study, Miller's [1992] uncertainty framework has been selected. This framework provides the opportunity to analyze the impact of both externals (competitors, exchange rates, etc.) as well as internal uncertainties (behavior, R&D, etc.) on capital budgeting practices. It also adopts a general management view by giving explicit consideration to numerous uncertainties rather than treating uncertainties in isolation from one another. Uncertainty is measured at the "organization unit" level within an organization. The concept of "organization unit" used in this study refers to organizations (business units, divisions, corporations) that have to file their annual reports.

By adopting this framework, it is expected that it is possible to discern between uncertainties that are dealt with in the investment decision and, as a consequence, uncertainties that are managed by operational, financial or other decisions. Previous research projects have adopted β (Haka et al [1985]; Schall & Sundem [1980]) or the standard deviation in returns or other performance measures (Kim [1982]; Klammer [1973]) as a measure of uncertainty. These measures of uncertainty do not provide any insight in the factors that determine the uncertainty measures. The application of Miller's [1992] framework provides an opportunity to investigate which specific uncertainties have an impact on capital budgeting practices and, apparently, are dealt with in the investment decision.

According to Miller [1992], managers may perceive as uncertain (1) the general environment, (2) the industry, or (3) organizational factors. Each of these categories encompasses a number of uncertain components, which will be discussed shortly:

- *General uncertainties* correspond to factors that affect the business context across industries. This category includes the following uncertainties (Vermeulen [1994]; Jongen [1991]):
  - *Political uncertainties* reflect the threats and opportunities associated with (potential or actual) major changes in political regimes and the political system. Political instability can result from war, revolution or democratic changes.
  - *Policy uncertainties* refer to the instability in government policies that impact the business community. Some of the most relevant types of government policy uncertainties are unanticipated fiscal or monetary reforms and changes in regulations.
  - *Macro-economic uncertainties* refer to fluctuations in the level of economic activity and prices (Oxelheim & Wihlborg [1992]). Price fluctuations may take the form of general price inflation, movements in the relative prices of inputs (such as raw materials or labor) and consumer goods, exchange rates and interest rates (Smith et al [1990]).

- *Social uncertainties* follow from the (changes in) beliefs, values, and attitudes of the population that are not (yet) reflected in current government policy or business practice.
- *Natural uncertainties* include natural phenomena that impact economic output such as hurricanes, earthquakes, variations in rainfall, and other natural disasters (Williams & Heins [1989]).

- *Industry uncertainties* refer to the uncertainties associated with differences in industry- and product-specific variables. This category includes:
  - *Input market uncertainties* refer to the industry-level uncertainties surrounding the acquisition of adequate quantities and qualities of inputs into the production process. Input market uncertainty may arise from either shifts in producer supplies or fluctuations in other users' demand for the input. Uncertainty surrounding the acquisition of inputs is particularly likely to occur in situations where there are only a few input suppliers.
  - *Output market uncertainties* refer to unexpected changes in the demand for an industry's output. Such shifts may be due to changes in consumer tastes or the availability of substitute products. The lack of availability of complementary goods, such as replacement parts, can adversely impact demand.
  - *Competitive uncertainties* cover the uncertainties associated with rivalry among existing firms and potential entrants into the industry (Porter [1985]).

- *Organizational uncertainties* are associated with firm-specific (or rather organization-specific[7]) factors. Organizational uncertainties include:
  - *Operating uncertainties,* which includes three subcategories of uncertainties: labor uncertainty, firm-specific input supply uncertainty, and production uncertainty. Labor uncertainties include changes in employee productivity due, for example, to labor unrest, strikes and unsafe work environments. Raw materials shortages, quality changes in inputs, and spare parts restrictions are all examples of firm operating uncertainties in the input supply category. Production uncertainty includes variations in output due to machine failure, accidents, and other random factors that disturb the production process.
  - *Liability uncertainties* are associated with unanticipated harmful effects due to the production or consumption of a company's product or production process (Williams & Heins [1989]). Firms may be held legally responsible for unanticipated negative effects associated with the use of a product, or for cer-

[7] For the purposes of this research project, the term "organizational" rather than "firm-specific" is deemed more appropriate. This change in terminology was driven by a practical reason: all firms are organizations, but not all organizations are firms. The change in terms makes application of the theoretical framework to non-private organizations (which are included in this research project) possible.

tain external effects such as the emissions of contaminants into the environment.

- *R&D uncertainties* are related to the lack of perfect foresight as to the connections between a firm's own R&D expenditures and the actual introduction of a new product or service. When investing in R&D, there is uncertainty surrounding the time frame for completing the project and the nature of the project's output.
- *Credit uncertainties* involve problems with collectibles. Default by clients on their debts to a firm can be a direct cause of variation in the firm's income stream.
- *Behavioral uncertainties* are associated with agency relations within a firm. Managers and employees of the organization often face incentives to increase their personal welfare at the expense of the firm's owners. Behavioral uncertainty is associated with individuals who take advantage of the organization's resources for personal benefit.

Previously, it has been stated that an increase in uncertainty is expected to covary with the application of more advanced capital budgeting practices. The results from previous research projects suggest that some measure for total uncertainty covaries with advanced capital budgeting practices. In addition to that, previous research has indicated that high technology and foreign investments involve expenditures in areas where the uncertainty about both the costs and the benefits is pronounced (Klammer et al [1991]). Also, Haka [1987] found that a decrease in the predictability of financial markets and competitor (re)actions resulted in the application of different capital budgeting practices. Chen [1995] found that environmental uncertainty (suppliers, competitors, customers, financial/capital markets and government regulatory agencies) also had an impact on capital budgeting practices.

Based on these results, it is expected that there are specific uncertainties (such as foreign exchange rates, interest and competition) associated with changes in capital budgeting practices. For the time being, it is not possible to identify (all) the specific uncertainties that covary with advanced capital budgeting practices: some uncertainties have been assessed by composite measures (see Chen [1995]). This results in the following hypotheses:

Hypothesis 3:
An increase in total uncertainty is associated with the application of more advanced capital budgeting practices.

Hypothesis 4:
An increase in specific uncertainties (such as foreign exchange rates, interest and competition) is associated with the application of more advanced capital budgeting practices.

3.4 Other Contingency Factors

The previous section of this thesis has discussed the impact of one contingent variable, uncertainty, on capital budgeting practices. The hypothesized relation is based on the assumption that uncertainty is the one variable that affects capital budgeting practices. This reductionism treats the anatomy of an organization as being decomposable into elements that can be examined independently. It is often assumed that the knowledge gained from each element can then be aggregated to understand the whole organizational system. However, several authors (Miller [1992]; Haimes [1992]; Drazin & Van de Ven [1985]) assert that the understanding of organizational relations can only advance by addressing simultaneously the many contingencies and performance criteria that must be considered holistically to understand organization design. It is possible that the effects of two contingency factors or two specific uncertainties offset each other. For example, it is possible that size (and associated market power, see Kotler [1988]) and competitive uncertainty (reaction of competitors) are negatively related. Also, policy uncertainties (vulnerability to government decisions) and macro-economic uncertainties (vulnerability to exchange rates) may be negatively related. Only a holistic approach may result in the recognition of the joint impact of a number of contingency factors. Thus, it is not sufficient to evaluate the relation between uncertainty and capital budgeting practices. Rather, it is necessary to identify other contingency variables that may have an impact on capital budgeting practices and to evaluate the interrelations between these variables.

There are numerous (contingency) factors that may influence capital budgeting practices. The decision on which factors to investigate is not a trivial task because of the limited knowledge of the relations between these factors and capital budgeting practices (Chen [1995]). The purpose of the contingency factors included in this study is, therefore, not to build a complete model that fully explains variations in the use of capital budgeting practices among organizations. Rather, this study tries to present a "first draft" of such a model, which may provide some directions for future research; in addition, the model is also the basis for matching organizations.

The capital budgeting literature contains a limited number of studies that try to link capital budgeting practices to contingent variables (Chen [1995]; Haka [1987]). Other research projects have indicated that size, industry (Ho & Pike [1992]; Haka et al [1985]; Kim [1982]; Klammer [1973]), technology (Cotton & Schinski [1999]; Slagmulder et al [1995]; Wilner et al [1992]; Klammer et al [1991]), environment (Chen [1995]; Haka [1987]) and organizational structures (Chen [1995]; Haka [1987]) have an impact on capital budgeting practices. The results on the relation between strategy and capital budgeting practices are inconclusive (Chen [1995]; Haka [1987]). Although most authors expect a link between strategy and capital budgeting practices (Slagmulder [1997]; Liberatore et al [1992]), empirical research projects have not yet fully discovered the specifics of such a link. Some of the contingency factors mentioned previously and there hypothesized relations with capital budgeting practices are discussed in more detail in this section.

Environment

The environment – including political, economic, and social trends, market trends, competitive trends, and product/technological trends – forces varying degrees of complexity and change on the organization (see Dessler [1986], p. 88). Relevant features of an organization's environment affecting the accounting system include the degree of predictability, the degree of competition faced in the market place, the number of different product-markets faced, and the degree of hostility exhibited. Two environmental characteristics have been used in previous research to investigate the relation between the environment and the capital budgeting practices of an organization (Haka [1987]). They are environmental predictability and heterogeneity. Environmental predictability (the "static-dynamic dimension") refers to the extent to which the environment is subject to change over time and is an important contributor to uncertainty in decision making (Waterhouse & Tiessen [1978]). Environmental (un)predictability can be regarded as a "composite substitute" for (some of) the external uncertainties in Miller's [1992] framework. Heterogeneity (the "simple-complex dimension") refers to the diversity in an organization's product-market orientations, consumer characteristics, raw materials markets, production technologies, and/or product markets (Gordon & Miller [1976]). Previous research has indicated that predictability is related to the application of discounted cash flow methods, while the results for heterogeneity are less clear[8] (Haka [1987]). Considering that an increase in dynamism and heterogeneity results in more uncertain environments, it is expected that they are related to the application of advanced capital budgeting practices. This results in the following hypothesis:

[8] It is noticeable that discounted cash flow methods are only one of the criteria used to classify organizations in this research project (see section 3.2). Therefore, the hypotheses are somewhat different from the hypotheses postulated by Haka [1987].

Hypothesis 5:
The dynamism of the organization's environment is positively related to the application of more advanced capital budgeting practices.

Hypothesis 6:
The heterogeneity of the organization's environment is positively related to the application of more advanced capital budgeting practices.

Technology

Technology can be described as the processes an organization uses for acquiring raw materials and transforming them into marketable products or services. Technology refers to the knowledge base of an organization on how to produce goods and services (Mintzberg [1979]). Every activity embodies technology, be it know-how, procedures or technology embodied in process equipment. The array of technologies employed in organizations may be very broad, ranging from those technologies used in preparing documents and transporting goods to those technologies embodied in the product itself.

According to Porter [1985], technological change is not important for its own sake, but is important if it affects competitive advantage and industry structure. Technology (or rather technological change) is expected to be an important contingency factor related to capital budgeting practices. Ansoff & McDonnell ([1990], p. 168) provide a dimension of technology deemed suitable for the purposes of this study: turbulence. Ansoff & McDonnell [1990] recognize three possible levels of technological turbulence:

- A *stable, long-lived technology* that remains basically unchanged for the duration of the demand life cycle is the first level of technological turbulence. Many of the first generation industries, which were founded at the end of the nineteenth century and began to reach maturity in the 1950s (such as the automotive industry) fit this description. Product proliferation is generally based on product features and design cosmetics rather than on technological advances in product performance.
- *Fertile technology* is the second level of turbulence: the basic technology is long-lived, but products proliferate, offering progressively better performance and broadening the field of application. Examples of fertile technology include data processing and pharmaceutical industries. Product development is a critical factor in economic success: the newest and best performing product captures the market. But its leadership is likely to be short-lived due to challenges from similarly effective or superior products offered by competitors. As a result, firms are under constant pressure to innovate.

- A *turbulent field of technology* is the third level of turbulence in which, in addition to product proliferation, one or more basic technology substitutions take place within the life span of the demand life cycle (for example, the vacuum tubes/transistor/chip-industry). The effects of technology substitution are further reaching than of product fertility, because they threaten obsolescence of the firm's entire investment in the preceding technology: in R&D know-how, in key scientific and technical personnel and in processing and manufacturing facilities.

These three levels of turbulence have been operationalized for the purposes of this study. A stable/long-lived technology has been operationalized as "all organizations within the industry use similar technologies". A fertile technology has been described as "technology offers the organization a chance to distinguish itself from others in the industry, but the technology does not change rigorously". A turbulent technology has been operationalized as "technology differs among organizations in the industry and is developing fast".

Previous research has indicated that technological change is a factor considered by managers in investment decisions (Keats [1991]). Research by Wilner et al [1992] indicates that organizations that make significant high technology investments tend to use more advanced capital budgeting practices. This results in the following hypothesis:

Hypothesis 7:
An increase in technological change is associated with the application of more advanced capital budgeting practices.

Strategy
An organization's strategy is the match between the organization's recourses and skills and the environmental opportunities and uncertainties it faces (Hofer & Schendel [1978], p. 11). It reflects, in other words, the course of action through which the organization plans to adapt to the threats and opportunities in its environment and thereby maintain its effectiveness. Strategy is the major link between the goals and objectives the organization wants to achieve and the allocation of (strategic) resources (see figure 3.2). Capital budgeting may thus be regarded as the end of the strategy formulation process (see also Liberatore et al [1992]).

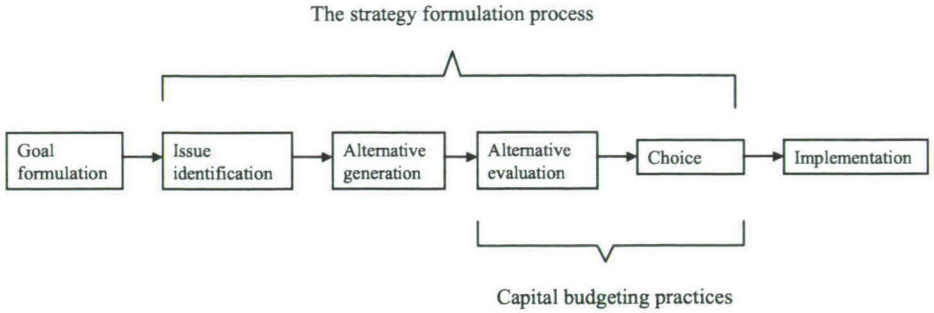


Figure 3.2: *The strategy formulation process*[9]

Hofer & Schendel [1978] differentiate between three levels of organizational strategy: corporate strategy, business strategy, and functional (or operational) strategy. For the purposes of this study, functional strategy has been replaced by (or interpreted as) investment strategy. After the discussion of the goals and objectives of organizations and the hypothesized relation with capital budgeting practices, each of these strategic levels will be discussed shortly.

Goals and Objectives

An organization can have numerous goals and objectives[10] (Kaplan & Norton [1992]; Hofer & Schendel [1978]; Simon [1964]). The following objectives are considered in this study:

- Operating profits, profit margins;
- (Generation of) cash flows;
- Shareholder value, dividends;
- Cost reduction (programs);
- Sales growth rate;
- Market share;
- Development of new markets and products;
- Research and development;
- Quality, customer/public value;
- Personnel development, human resources;
- Political and public effects;
- Ethical performance of the organization.

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9 Adapted from Hofer & Schendel [1978], p. 6; and Liberatore et al [1992], p. 36.

10 Hofer & Schendel ([1978], p. 20) observe that the terms goals and objectives are sometimes differentiated and sometimes used synonymously in the management literature. For the purposes of this study, the terms are used as synonyms.

Theoretically, organizations should select investment projects that help to achieve the objectives of the organization within the uncertainty and return boundaries set in the investment policy. The capital budgeting practices used to evaluate investment projects should help to select from a group of mutually exclusive projects the one that maximizes effectiveness. Effectiveness is concerned with the attainment of objectives; an action is effective to the extent that it achieves what it was intended to achieve. It is assumed that organizations implement those capital budgeting practices that help to increase effectiveness. Therefore, organizations with different objectives are expected to implement different capital budgeting practices.
For example, an organization that has as its major objective to supply certain services at the lowest possible costs will probably use different capital budgeting practices to evaluate a investment projects than an organization that has maximizing cash flows as its major objective.

There is few empirical evidence on the relation between the objectives of an organization and its capital budgeting practices. Liberator et al [1992] use the Analytic Hierarchy Process (AHP) in a Mission, Objectives and Strategy (MOS) environment to link capital investments to the objectives of the organization. Based upon an analysis of the objectives of several oil companies, they are able to demonstrate that each company is expected to evaluate investment projects on different criteria. Chen [1995] has shown that the importance of the stockholder wealth objective is associated with the application of DCF-techniques (at the expense of the accounting rate of return and payback criterion as evaluation criteria). Finally, finance theory states that DCF-techniques are consistent with the objective of shareholder maximization. This results in the following hypothesis:

Hypothesis 8:
The objectives of an organization are related to capital budgeting practices.

The impact of capital budgeting decisions on operating profit/profit margin and cost reduction is best evaluated by the accounting rate of return; therefore, the importance of these objectives is expected to be associated with accounting methods (accounting rate of return, payback method). The achievement of (long-term) financial objectives such as the (generation of) cash flows and shareholder value/dividends are best evaluated by discounted cash flow- and real option pricing theory- methods; therefore, they are expected to be related. The previous hypothesis can be divided in two sub-hypotheses:

Hypothesis 8a:
The importance of the objectives "Operating profits/profit margins" and "Cost reduction (programs)" is associated with simple capital budgeting methods.

Hypothesis 8b:
The objectives "(Generation of) cash flow" and "Shareholder value/dividends" are associated with the application of advanced capital budgeting practices.

Corporate Strategies
The corporate level in today's organization must deal with operating divisions, groups of divisions, and even separate legal business entities (Hofer & Schendel [1978], p. 27). Corporate strategy is concerned primarily with answering the question: what set of businesses should we be in? Organizations can be classified into one of three categories with regard to their corporate strategy. A "single business" organization operates in one line of business; in its most extreme form, the organization may be totally committed to one industry. A "related diversified" organization operates in several industries; it possesses core competencies that benefit many of its business units and accomplishes diversification by relating new businesses to old. These organizations set out to exploit operating synergies across businesses. Related diversified organizations typically grow through internal research and development. Finally, an "unrelated diversified" organization (or conglomerate) operates in a number of businesses and industries that are unrelated to one another. The headquarters of an unrelated diversified organization function as a holding company, lending money to business units that are expected to have high financial returns. Conglomerates diversify their activities primarily through acquisition.

For corporate strategy, there are two conflicting issues associated with the sophistication of capital budgeting practices. The first issue relates to the fact that unrelated diversified organizations as a whole are expected to face less uncertainty than single business organizations. Unrelated diversified organizations have combined their assets in one "portfolio organization" and diversification reduces variability in income streams. Considering their large asset base invested in several industries, portfolio organizations may be able to compensate a decline in the income stream of one business unit by an increase in the income stream of another. At the other extreme, single business organizations have devoted their resources solely to one industry; therefore, their returns are much more dependent upon the state of that industry. Considering that single business organizations are more volatile to changes in one industry, it is likely that they rely more on advanced capital budgeting practices than unrelated diversified organizations to manage the uncertainties associated with their corporate strategy (the "diversification effect").

The second issue is associated with the notion that unrelated diversified organizations have to invest in new industries to achieve their growth objectives. Since these new industries are unfamiliar to them, the uncertainties and uncertainties associated with these new investments are fairly large. All that is available to the unrelated diversified organization are new, relatively uncertain data. New investment opportunities are expected to be carefully analyzed to assure that they fit within the current portfolio (the corporate portfolio approach; see Drury [1992], p. 407). Single business organizations invest in an industry in which they have been operating for years; they can rely on historic data and up to date knowledge of the market, all the way up to top management (Lillis [1992]). The need for a careful evaluation of investment opportunities may therefore be less necessary in single line business organizations, since top management has the same information as other management levels within the organization. Also, functional background of corporate management in unrelated diversified organizations is mainly finance (see Anthony et al [1992], p. 693), which may result in a more formal analysis of uncertainty. Another consideration is that the application of more advanced capital budgeting practices may result in diversification (i.e., the recognition of uncertainty in the investment process results in the adoption of a portfolio model to manage these uncertainties). Finally, Amigoni [1978] points out that with increasing structural complexity, any tool (for example, uncertainty analysis or financial modeling) can be added to those previously in use. This suggests that diversification results in an evolution towards more advanced capital budgeting practices (the "familiarity effect"). The previous observation result in the consideration that unrelated diversified organizations are more likely to use advanced capital budgeting practices.

Based upon this analysis, it is concluded that theory does not reveal a clear direction on how to link corporate strategy to capital budgeting practices. Also, there is little empirical research on the relation between corporate strategy and capital budgeting practices. In three case studies, Lillis [1992] found that the structure of the organization (divisions) and the long-run strategic plan are closely related to the capital investment decisions made by companies. However, the specifics of this relation are not clear: it is not known which of the effects mentioned previously ("diversification" versus "familiarity") will prevail for the general typology of corporate strategy used in this study. This results in the following hypothesis:

Hypothesis 9:
There is no relation between corporate strategy and the application of advanced capital budgeting practices.

Business Unit Strategies

Business unit strategies deal with how to create and maintain a competitive advantage in each of the businesses in which an organization participates. At the business level, strategy focuses on how to compete in a particular industry or product/market segment. Scope becomes less important than at the corporate level and is concerned more with product/market segmentation choices and with the stage of product/market evolution than with the breadth or depth of product/market scope (Hofer & Schendel [1978], p. 29).

Different strategy typologies and variables have been used in research on the relation between management accounting systems and strategy (Langfield-Smith [1997]). Miles & Snow [1978] describe three successful organizational types: defenders, prospectors and analyzers. This typology focuses on the rate of change in products or markets. Miller & Friesen [1982] categorize firms as conservative or entrepreneurial, using the extent of product innovation. The two types of firms differ in their degree of environmental hostility, organizational differentiation and environmental heterogeneity. Porter [1985] describes three generic strategies: cost leadership, differentiation and focus. Each of these intended strategies provides a basis for a sustainable competitive advantage within an industry and potentially defines the contact for actions in each functional area of the organization. The successful implementation of each strategy involves different resources and skills, supportive organizational arrangements and control systems. The classification of build, holds, harvests and divests focuses on variations in strategic missions (Kotler [1988], p. 42; Gupta & Govindarajan [1984]). The choice of strategic mission signifies the organization's intended trade-off between market share growth and maximizing short-term earnings.

The build, hold, harvest and divest-classification has been used for the purposes of this study. The other strategy classification cover some of the uncertainties mentioned previously (defender, prospectors and analyzers; conservative or entrepreneurial) or were considered too narrow for the purposes of this research project (cost leadership, differentiation)[11].

Again, as for corporate strategy, there are two possibly conflicting issues associated with the relation between business strategy and capital budgeting practices. The first issue is that, for several reasons, "build" units tend to face greater environ-

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11 In a review of the common characteristics of the typologies and variables, particularly with regard to environmental uncertainty, Langfield-Smith [1997] proposes a classification of strategies. Based on this classification, a comparison of results from studies on strategy becomes possible. The classification developed by Langfield-Smith [1997] may also be useful for the comparison of the results from this study to previous studies on the relation between (business unit) strategy and capital budgeting.

mental uncertainty than "harvest" units (see Anthony et al [1992], p. 698; Gupta & Govindarajan [1984]). First of all, build strategies are typically undertaken in the growth stage of the product life cycle, whereas harvest strategies typically are undertaken in the mature/decline state of the product life cycle. Factors such as manufacturing process, product technology, market demand, relations with suppliers and buyers, distribution channels and so on change more rapidly and more unpredictably in the growth than in the mature/decline stage of the product life cycle. Second, an objective of a build business unit is to increase market share. An increase in market share can only be achieved if competitors lose market share; therefore, a build strategy is expected to disrupt industry structure and intensify competition in the industry. Third, both on the input side and on the output side, build managers tend to experience greater dependencies with external individuals and organizations than harvest managers. The greater the external dependencies that the business unit faces, the greater the uncertainty it confronts. Finally, the experience of build managers in their industries is likely to be relatively low since they often operate in new and evolving industries. Considering these greater uncertainties, build units may use more advanced capital budgeting practices to deal with these uncertainties (the "growth effect").

A second, contrary issue is associated with the fact that harvest units tend to rely on more formalized capital expenditure decisions and more financial capital expenditure evaluation criteria (Anthony et al [1992]). The sophistication of capital budgeting practices is generally associated with more formal uncertainty- and financial analysis tools (Ho & Pike [1992]). A harvest business unit operates in a mature industry and does not offer tremendous new investment possibilities; hence, DCF-techniques can be used with more confidence (see also Haka [1987] for an elaboration on this argument). On the contrary, a build unit is positioned on the growth stage of the product life cycle; given the product/market uncertainties, financial analysis of investment projects from build units may be unreliable. Build unit managers will tend to display a greater tolerance for ambiguity (Shank & Govindarajan [1989]; Gupta & Govindarajan [1984]) and tend to rely more on non-financial evaluation criteria. Considering the formalization of procedures, it is expected that harvest units tend to apply more advanced capital budgeting practices (apply capital budgeting procedures that formally evaluate uncertainty; the "formalization effect").

Empirical evidence on the relations between business unit strategies and capital budgeting practices is also mixed. A field study by Slagmulder [1997] indicates that the evaluation and selection of investment projects is altered after the competitive environment and the change in (business unit) strategy. Case study evidence presented by Shank & Govindarajan [1989] indicates that harvest business units rely

on more quantitative and financial analysis methods (i.e., apply more advanced capital budgeting practices) than build units. These studies suggest that business unit strategy has an impact on capital budgeting practices. However, Haka [1987] analyzed the impact of the three strategic types of organizations identified by Miles & Snow [1978] (defenders, analyzers and prospectors) on the application of DCF-techniques. Haka's [1987] results did not signal a significant relation between strategy and capital budgeting practices. Similar results were obtained by Chen [1995], who did not find a relation either between firm strategy (measured by the Miles & Snow typology) and capital budgeting practices. Apparently, it is not clear which of the effects mentioned previously ("growth" versus "formalization") prevails. This results in the following hypothesis:

Hypothesis 10:
There is no relation between business unit strategies and the application of advanced capital budgeting practices.

Functional Area Strategy
At the functional area level, the principal focus of strategy is on the maximization of resource productivity. Synergy and the development of distinctive competencies, therefore, become the key strategy components, while scope drops sharply in importance. Here, synergy involves the coordination and integration of activities within a single function (Hofer & Schendel [1978], p. 29). In the field of capital budgeting, the investment strategy is considered the relevant functional area strategy. Collis [1992] has developed a strategic approach to the management of uncertainty in investment decisions which is based upon the timing and breadth of investments (see figure 3.3).

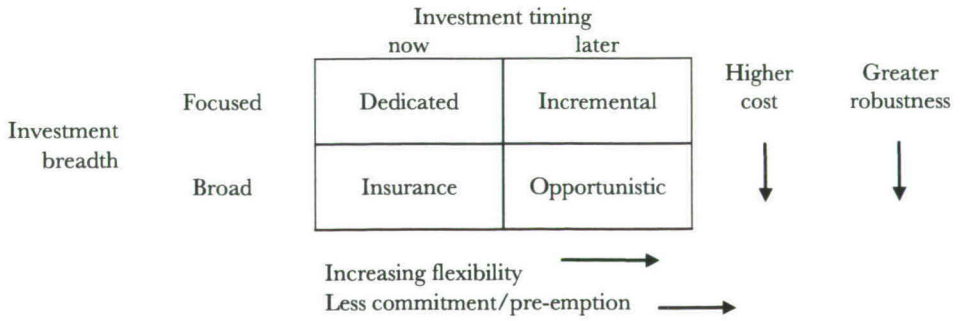

Figure 3.3: *Generic investment strategies*[12]

[12] Adapted from Collis [1992], p. 126.

The previous generic approaches differ in the pattern and timing of their resource commitments (see Collis [1992]):

- The *insurance approach* reduces uncertainty by committing the organization to multiple investments that guarantee a return to the organization under all foreseeable future events. Under this investment approach, the organization operates as a "portfolio manager": by selecting the "right" investment projects under consideration, the organization reduces the uncertainty confronting the organization.
- The *incremental approach* reduces uncertainty by delaying investment until it is absolutely necessary to support the strategy or until key uncertainties have been resolved favorably. Even then, continuing investment is contingent on the achievement of pre-specified performance levels. The essence of the incremental investment strategy is that it is sequential and gradually escalates in response to improving information. Under this approach, organizations can rely on historic information (such as consumer test information, regional test market information, and manufacturing information; Collis [1992], p. 128).
- The *dedicated approach* is predicated on the belief that the uncertainty will resolve itself in a certain way. This approach requires focused investments that commit the organization to one specific strategy. This strategy maximizes the payoff if the uncertainty resolves itself the way the strategy assumed, but it provides no security if the outcome is any different.
- The *opportunistic approach* is almost the negation of strategy. It emulates an "entrepreneurial" approach where strategy is not pre-determined but adopted and altered as uncertainties are resolved and opportunities open and close. It employs a strategy of organizational flexibility and responsiveness rather than asset investment. The opportunistic approach aims to capitalize on unanticipated opportunities as they develop; however, organizations that use this approach forgo the possibility of harvesting the long-term results that a sustainable competitive advantage from pre-emptive investments can offer.

No empirical research has been found with regard to the relation between investment strategies and (advanced) capital budgeting practices; however, it is possible to derive some (hypothesized) relations from the characteristics of the approaches. It is expected that organizations that use an insurance approach will evaluate what portfolio of investment projects offers the optimum return, considering the uncertainties enclosed in various projects. It is likely that these organizations employ relatively advanced capital budgeting practices: the investment projects under consideration will be studied intensely and adjusted to ascertain the projected return for the organization as a whole.

The opportunistic approach is expected to be associated with operational uncertainty management practices (temporary labor, flexible contracts) rather than with

the application of advanced capital budgeting practices. For the other investment strategies, it is hard to say in advance if they are associated with advanced capital budgeting practices. This results in the following hypotheses:

Hypothesis 11:
The investment strategy of an organization is related to its' capital budgeting practices.

This hypothesis can be subdivided in the following sub-hypotheses:

Hypothesis 11a:
The insurance approach of an organization is positively related to the application of advanced capital budgeting practices.

Hypothesis 11b:
The opportunistic approach of an organization is positively related to the application of relatively simple capital budgeting practices.

Hypothesis 11c:
The other investment strategies (dedicated, incremental) are not associated with the application of advanced capital budgeting practices.

Size

Previous research has indicated that the size of organizations is associated with the application of advanced capital budgeting practices (Segelod [1998]; Ho & Pike [1996]; Klammer et al [1991]; Kim [1982]; Schall & Sundem [1980]). Apparently, there are some economies of scale associated with the application of advanced capital budgeting practices. One reason may be that the structural application of uncertainty analysis tools in the capital budgeting process requires (investments in) advanced information systems. Larger firms are much more likely to have full-time staff members for capital budgeting and make considerable capital expenditures for new plant and equipment, which require the use of more sophisticated capital budgeting practices. Based on previous results, the following hypothesis is formulated:

Hypothesis 12:
An increase in size is positively related to an increase in the application of advanced capital budgeting practices.

Industry

Previous research has indicated that capital budgeting practices seem to differ among industries (Ho [1992]; Haka et al [1985]; Aggarwal [1980]). In general, manufacturing firms tend to use more advanced capital budgeting practices than service firms. One potential explanation is that the nature of the investments (tangible versus intangible) has an impact on capital budgeting practices. Recent research by Segelod [1998] has slightly corrected this point of view. Segelod [1998] found that both manufacturing and service firms use DCF-techniques, but that such evaluations in service groups are few and done by managers or a staff unit. Another explanation for the relation between industry and capital budgeting practices is the observation that some organizations (pharmaceutics, other organizations with large market and/or product development investments) have a very large R&D budget compared to the capital investment budget (Segelod [1997]). In such organizations, the results from the R&D projects decide which capital investments are made; the R&D manual and procedures for evaluating the progress of R&D projects take precedence over the allocation of capital for fixed investments, and this reduces the importance of (advanced) capital budgeting practices. This results in the following hypothesis:

Hypothesis 13:
Industry has an impact on capital budgeting practices.

3.5 Performance

Some researchers have explored the connection between sophisticated capital budgeting practices and the performance of organizations (Chen [1995]; Ho [1992]; Haka [1987]; Haka et al [1985]; Kim [1982]; Klammer [1973]). Sophisticated capital budgeting practices have usually been interpreted as the use of at least DCF-methods, and possibly of operations research techniques such as simulation and linear programming methods (Northcott [1992], p. 106). The performance of organizations has typically been measured by financial measures such as stock price performance (Haka et al [1987]), return on assets (Chen [1995]; Klammer [1973]) or earnings performance (Ho [1992]; Kim [1982]). Researchers generally expected that the performance of the organization would increase after the adoption of advanced capital budgeting methods, or that organizations that use advanced capital budgeting practices outperform organizations that use relatively simple capital budgeting practices. The majority of work in this area has found no significant relation between the level of sophistication in capital budgeting practices and performance. The lack of a relation between sophisticated capital budgeting practices and (accounting) performance is not surprising, since the variance in profit is relatively

large[13]. In addition to that, there are so many factors that affect profit that it is very hard to isolate the effects of one of them. Therefore, the relation between uncertainty, capital budgeting practices and performance is probably hard to prove statistically.

The basic hypothesis posited in this research project is that the performance of an organization is a function of capital budgeting practices and the moderating effects of uncertainty. There are several options available to investigate this relation (Haka et al [1985]; Drazin & Van de Ven[14] [1985]; Harrison et al [1983]):

- *Interaction approach:* the focus of this approach is on explaining variations in organizational performance from the interaction between two variables (e.g., capital budgeting practices and uncertainty);
- *Matched pairs approach*: the focus of the matched pairs approach is on comparing the performance of two fairly similar ("matched") organizations that employ different accounting methods (for example, different capital budgeting methods);
- *Systems approach:* simultaneously, many contingencies (uncertainty, capital budgeting practices, size, strategy) and performance criteria are considered holistically to understand the (inter) relations between them.

Each of these approaches is discussed shortly.

Interaction approach

A contingency framework linking uncertainty, capital budgeting practices and performance is presented in figure 3.4.

		Capital budgeting practices	
		Simple Capital Budgeting Practices	Advanced Capital Budgeting Practices
Uncertainty	Low	Group A Congruent Higher performance	Group B Incongruent Lower performance
	High	Group C Incongruent Lower performance	Group D Congruent Higher performance

Figure 3.4: *Contingency framework linking uncertainty, capital budgeting practices and performance*

13 Profit is the difference between revenues and costs; therefore, the variance in profit is the sum of the variances in revenues and costs.

14 Drazin & Van de Ven [1985] note that there are three approaches to investigate contingency theory: the selection, interaction and systems approach. The selection approach is deemed not relevant for this study, since it investigates the relation between two variables. The current study investigates the relations between (at least) three variables: uncertainty, capital budgeting practices and performance. In addition, the interrelations between uncertainty and other contingencies are investigated.

It was mentioned previously that the expected costs of uncertainty are highest for "high uncertainty organizations"; therefore, it is expected that these organizations use advanced capital budgeting practices to identify and manage uncertainty in the investment decision. This group is presented in figure 3.4 as group D: these organizations utilize costly information to prevent them from investing in the "wrong" projects. Their average performance is relatively high, while the variability for performance is expected to be relatively low compared to their counterparts in group C. On the other hand, organizations with advanced capital budgeting practices are expected to underperform when uncertainty is low: in that situation, they utilize costly information that hardly helps them to invest better. The average performance for this group is relatively low, and variability is also relatively low (group B). In situation where uncertainty is (relatively) low, organizations that utilize relatively simple capital budgeting practices (group A) are expected to outperform their counterparts that use advanced capital budgeting practices (group B). This results in the following hypotheses:

Hypothesis 14:
"High uncertainty organizations" that apply advanced capital budgeting practices achieve a higher performance than their counterparts that use simple capital budgeting practices.

Hypothesis 15:
"Low uncertainty organizations" that apply relatively simple capital budgeting practices achieve a higher performance than their counterparts that use advanced capital budgeting practices.

Matched pairs approach

As a substitute for random assignment, researchers often seek to "match" subjects in terms of known characteristics. Matching is often used in field experiments in organizational research (Bryman [1989], p. 27). The ideal test in this research project to determine the impact of capital budgeting practices on performance would be to compare the average performance of an organization over a time period when it uses sophisticated techniques with its average performance over the same time period while it uses naive techniques. Unfortunately, this approach is not possible. An alternative is to match a firm which switched from a naive to a sophisticated technique (i.e., an experimental firm) with one using a naive technique (i.e., a control firm) over the same time period (see Haka et al [1985]). This approach is not possible either, since data on the timing of switches in capital budgeting practices are not available.

A third possibility is the "post-test-only equivalent control group experiment" (see Bryman[15] [1989], p. 83). This experiment allows the researcher to discern whether there are differences between the two groups in terms of the dependent variable (in this case, performance) while controlling for (cross-sectional) variables that may interfere with the hypothesized relation. The research design for this approach is presented in figure 3.5.

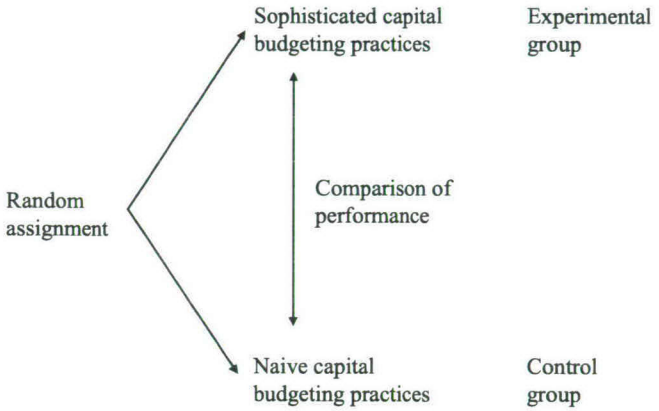

Figure 3.5: *Research design or post-test-only equivalent control group experiment*

The tests for a difference in performance are performed on the series of observations for each matched pair:

$$d_{tj} = R^e_{tj} - R^c_{tj}$$

where d_{tj} is the difference in return between the performance for an experimental organization, R^e_{tj}, and the performance for a control organization, R^c_{tj} (t=1, ..., m years; j = 1, ..., n organizations).

One of the important variables in the experiment is uncertainty; that is, the performance of the matched organizations is compared among two groups (low uncertainty and high uncertainty). The Kruskal-Wallis test is used to determine whether the average difference in performance between the two matched organizations is different from zero. The hypotheses associated with the matched pair's approach are similar to the hypotheses for the interaction approach; however, the matched pair's approach controls for the interaction of specific variables.

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15 Technically, other "matched pairs studies" have used an "equivalent control group experiment with pre- and post-testing" (see Haka et al [1985]; Larcker [1983]). These studies have investigated whether the stock market reacted to *changes* in accounting practices.

Systems approach

The systems approach emphasizes the need to adopt multi-variate analysis to examine patterns of consistency among several contingency factors (uncertainty, size, strategy), capital budgeting practices and performance. The systems approach maintains that two basic choices confront the researcher: to select the patterns that match the set of contingencies facing the firm, and to develop structures and processes that are internally consistent (Drazin & Van de Ven [1985]).

The previous sections of this thesis have provided some hypothesized underlying patterns of contingency factors. It is hypothesized that *Simple Risk Adjusters* (SRA-users: see section 3.2) are expected to perform best in a situation where there is little uncertainty, little dynamism and heterogeneity in the environment and a stable technology. Generally, SRA-users are expected to be relatively small organizations that have cost reduction or increase of profit as important goals. *Probability Risk Adjusters* (PRA-users) are expected to perform well in case of medium to high uncertainty, medium to high dynamism in the environment and a fertile technology. Profit maximization and cash flow generations are assumed to be important goals of these medium-sized to large organizations, and an insurance investment strategy is used to achieve that goal. Finally, *Game/Option Theory Adjusters* (GOTA-users) are expected to perform well in case of high uncertainty, a highly dynamic environment and a turbulent technology. Generations of cash flows, dividends and shareholder value are expected to be important goals of these large organizations and an insurance strategy is used to achieve that goal. This results in the following hypothesis:

Hypothesis 16:
There are certain consistency patterns in contingencies that determine whether the application of advanced capital budgeting practices is associated with higher performance.

The previous hypothesis is elaborated in following sections of this thesis.

3.6 Summary

The theoretical framework that is tested in the next chapters has been presented in this chapter. The basic proposition of this study is (1) that high [low] uncertainty is associated with sophisticated [naive] capital budgeting practices, (2) that other contingency factors [jointly with uncertainty] are related to specific capital budgeting practices, and (3) that a stronger fit between uncertainty, [other contingency factors] and capital budgeting practices is associated with higher performance. The argument developed in this chapter contends that this situation results from the fact that the expected costs of uncertainty are higher for "high uncertainty organizations". It is expected that these organizations are more willing to invest in advanced (or sophisticated) capital budgeting practices to deal with these uncertainties in a systematic manner and thus to ensure continuity of the organization. "Advanced capital budgeting" refers to capital budgeting practices that identify and analyze uncertainties, adjust for these uncertainties and base their investment decision on a capital budgeting decision rule that considers these uncertainties in a structural, systematic manner.

To measure the degree of uncertainty, the general management framework to uncertainty by Miller [1992] has been used. Miller's [1992] framework distinguishes between general uncertainties (political, policy, macroeconomic), industry uncertainties (input market, output market, competitive) and organization-specific uncertainties (labor, production, behavior). The recognition of these constituent uncertainties provides the possibility to investigate the relationships between individual uncertainties and capital budgeting practices, as well as to construct a general measure of uncertainty that encompasses these individual uncertainties. Both the internal as well as the external uncertainties that may affect an organization are included in the framework.

In addition to uncertainty, there are other factors that may have an impact upon capital budgeting practices. These factors include the environment (heterogeneity and dynamism), technology (level of turbulence), strategy (goals and objectives, corporate strategy, business unit strategy and investment strategy) and size. The theoretical framework is presented in figure 3.6.

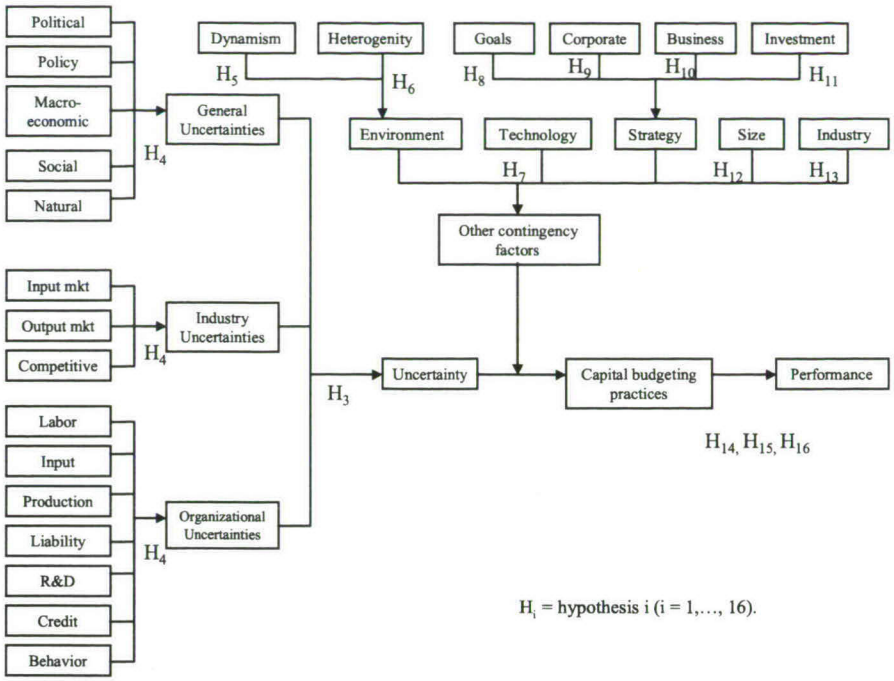

Figure 3.6: *Research framework*

CHAPTER 4

METHODOLOGY AND DATA

4.1 Introduction

The conducted steps in the empirical research are discussed in this chapter. Section 4.2 provides the design of the study; it discusses at which organizational level the study has been conducted and why these units were chosen. Section 4.3 presents the instruments that have been used to measure capital budgeting practices, uncertainty, other contingency studies and performance. It also provides a justification for using these instruments. Section 4.4 deals with the methods that have been used to gather the necessary data for this research project. This section discusses the choices that have been made in terms of organizations, respondents, and the way in which the data collection has been carried out. Finally, section 4.5 summarizes the chapter.

4.2 Design of the Study

The study is meant to explore whether different levels of uncertainty are associated with the application of different capital budgeting practices, both directly and through "consistent patterns". Also, the impact on performance from a match between uncertainty, (other contingency factors) and capital budgeting practices is evaluated.

Considering the explorative nature of the study (Segers [1980]), as many factors as possible are identified and included in the descriptive model; additional research may reveal whether these variables are rightfully included. Finally, the construction of the model may result in the application of several statistical tests or the reclassification of variables. These actions are not intended to increase the explanatory power of the model, but to "sharpen" the outline of the descriptive model. In fact, the inclusion of as many (potential) determinants as possible reduces the explanatory power of the model; the reduced power is considered less important than the construction of a holistic descriptive model.

It is argued that the organizational unit that has to file annual reports is the suitable level for analysis. Also, it is argued that the finance department, in particular, is acquainted with (and may very well determine) the capital budgeting practices used in the organization. Lastly, the appropriate research method has to be chosen; a survey in combination with literature and/or archival research are deemed the most suitable research methods.

4.2.1 Organizational Level

An important question in the research design is the relevant organizational level that has to be addressed. The literature suggests that much of the analysis and decision-making in capital budgeting is conducted at lower organizational levels, although the responsibility often rests with top management (Northcott [1992]; Scapens & Sale [1981]). Thus, it is possible to study capital budgeting practices both at the corporate level and at the business unit level.

For the purposes of this study, a pragmatic approach also used by other capital budgeting researchers has been adopted (Ho & Pike [1996]; Wilner et al [1992]; Gitman & Mercurio [1982]). The current study uses a sample of 704 large organizations operating in the Netherlands, drawn from the REACH CD-ROM database[16]. All organizations in the selection have to file their annual report; therefore, the financial results (necessary for an evaluation of performance) are available for these organizations over several years.

To select the organizations, three criteria have been used: (1) sales have to exceed *f* 60 million [about € 27 mln], (2) total assets have to exceed *f* 45 million [about € 20 mln] and (3) costs for personnel have to exceed *f* 35 million [about € 16 mln]. Since the number of employees (or full time equivalents, fte's) is not listed in the REACH CD-ROM database, the last selection criterion has been used to select organizations with at least 400 employees. The selection criteria apply to sales, total assets and costs of personnel in the Netherlands as well as in other countries. For example, a large foreign corporation that meets the criteria internationally is enclosed in the survey, even if its' operations are relatively small in the Netherlands. In addition to that, the organizational units with business activities from the 12 largest communities in the Netherlands have been retrieved from a database on Dutch communities. Considering the organizational level, the findings of this study are obviously biased towards large and, quite often, successful business (like) or-

[16] REACH is the name of a CD-ROM database that contains data on all organizations registered at the Dutch Chamber of Commerce.

ganizations in the Netherlands; the results may not be generalizable to small and medium-sized organizations.

The criteria that have been used to select organizations may result in the fact that both a (or several) business unit(s) and the corporate level of a diversified organization are included in the sample. For example, there are several business units within a large diversified organization that (may) fit the criteria mentioned previously. Theoretically, it is possible that all business unit levels as well as the corporate level respond to the capital budgeting survey. It is assumed that the answers provided by the respondents reflect the situation of their organizational unit: the business units for their activities (e.g. banking, insurance) and the corporate level for its activities (e.g., financial institutions). The answer on business strategy for the corporate level is assumed to provide the intended strategy for the organization as a whole (e.g., which sort of business units to acquire). The business unit strategy for the business units refers to the strategy for specific product market combinations (e.g., which products/markets to develop). The answers provided by the (few) respondents that operate within one organization seem to confirm this assumption. The answers on corporate strategy provided by business unit(s) and corporate level are mostly similar, but the answers on business unit strategy differ among the diverse business units and between business unit and corporate level within one organization.

Some organizations that fit the criteria described previously are holding companies that have their statutory seat in the Netherlands (mainly for tax purposes). The actual operations of these organizations are not in the Netherlands; investment projects of these organizations are generally analyzed, decided upon and implemented in other countries. Such organizations have been excluded from the sample. The previous procedure results in the fact that the organizational units included in the sample may be considered investment centers or (at least) profit centers that make considerable investments in the Netherlands. An executive who has responsibility for costs, revenues and at least some discretion over capital expenditures (similar to Scapens & Sale [1981]) heads the organizational units in the sample.

4.2.2 Level of Measurement

There are a number of approaches to assess the relation between uncertainty and capital budgeting practices of organizations. For example, it is possible to let general management, an executive committee, functional management (finance, accounting), technical staff, or other persons involved in the capital budgeting process describe the capital budgeting practices assess the level of uncertainty. Previous research has indicated that the finance department is generally involved in (the

preparation of) capital budgeting decisions (Northcott [1992]; Mukherjee & Henderson [1987]; Scapens & Sale [1981]). It is expected that senior financial executives are fully conversant both with the capital budgeting practices as well as with the contingency factors (strategy, technology, etc.) of their respective organizations. Therefore, it has been decided to measure the relevant issues from the chief financial officer's point of view. All organizations in the sample have been contacted to retrieve the name of the chief financial officer (CFO) of the organization. Several surveys in other research projects use a procedure similar to the one described here (see Herst et al [1998]; Slagmulder et al [1995]; Chen [1995]; Pike & Ho [1991]; Haka [1987]).

4.2.3 Research Design

There are a number of research designs, including survey research, experimental research, qualitative research, case study research and action research (Bryman [1989], p. 29). For the purposes of most of this study, survey research has been deemed most suitable. Survey research entails the collection of data (usually by interview or by questionnaire) on a constellation of variables and usually at a single juncture in time. The objective then is to examine patterns of relationship between the variables. The relevant variables in this study are capital budgeting practices, uncertainty, other contingency factors and performance. All variables are measured at the level of the organizational unit. The next section discusses the instruments employed to measure the variables.

Some authors disapprove of the use of capital budgeting questionnaires (Segelod [1997]; Wallace & Mellor [1988]; Aggarwal [1980]; Rappaport [1979]). The results of capital budgeting surveys have been criticized by these authors for failure to address the non-response problems in the design of the study and difficulties in comparing results from surveys based on different samples. Also, it is claimed that the response prompted by a survey reflects the information available to the manager who answers the questionnaire; they do not always reflect the corporate-wide situation. Despite these difficulties, mail questionnaires provide one of the best means of eliciting information from a population that is widely dispersed and may prefer anonymity. Some (qualitative) checks have been used to estimate the effects mentioned previously on the findings of this study.

4.3 Measurement Instruments

This section describes the instruments used to measure capital budgeting practices, uncertainty, other contingency factors and performance.

4.3.1 Capital Budgeting Practices

Several studies have surveyed the application of capital budgeting practices in organizations, both in the Netherlands as well as in other countries (Herst et al [1998]; Ho & Pike [1996, 1991]; Pike [1996]; Van Cauwenbergh et al [1996]; Slagmulder et al [1995]; Chen [1995]; Klammer et al [1991]). The capital budgeting survey that has been used in this study is similar to the surveys in most studies, in a sense that it has asked respondents to indicate what methods and instruments they use in capital budgeting practices on a (ir) regular basis.

A number of measurement instruments have been used to survey capital budgeting practices. The ranking method used in some other studies results in forced choices, which may lead to some information loss in that respondents are not allowed to dislike any of the objects on the list nor to give ties to two objects (Chen [1995]). Also, previous studies have indicated that organizations use several uncertainty identification and analysis methods and/or capital budgeting decision rules at the same time (Herst et al [1998]; Pike [1996]; Sangster [1993]). Likert-type scales have been used in this study, giving respondents the opportunity to indicate which elements from capital budgeting practices they use on a regular basis.

The survey has asked respondents to indicate which of the following methods and instruments they use on a regular basis in the capital budgeting process (the numbers refer to the number of the questions in the survey; see *Appendix 4.1*):

- *Uncertainty identification (19):* A number of uncertainty identification methods have been presented, including checklists of potential losses, (projected) financial statement analysis, flow chart analysis, on-site inspections, interactions with other organizational units or outsiders, contract analysis, analysis of statistical records and analysis of the environment.
- *Uncertainty analysis (18):* Among the uncertainty analysis methods available are sensitivity analysis and break-even analysis, scenario analysis, Monte Carlo simulation techniques, decision trees and CAPM analysis (analysis of β in similar projects).
- *Adjustments for uncertainty (17):* There are a number of methods to adjust projects for the uncertainties encountered in projects, including: shortening the payback period; raising the required rate of return for the investment project; risk ab-

sorption; adjusting expected values; and using certainty equivalents instead of expected cash flows.

- *Capital budgeting selection rules (16):* among the possible selection rules are the pay-back rule, accounting rate of return, profitability index, internal rate of return, net present value, real option pricing theory, game theory decision rules and non-financial techniques.

In the survey, respondents have been asked to indicate which of these methods and techniques they use in capital budgeting practices. In addition to the pre-structured answers, organizations could also indicate that they use different methods and techniques; in that case, they were asked to elaborate on their answer.

4.3.2 Uncertainty

The instrument for the uncertainty construct is designed to measure the impact of uncertainty on the projected results of the organizational unit under consideration. It has also been designed to capture external as well as environmental uncertainties (see chapter 3). For the purposes of this study, uncertainty is measured by operationalizing Miller's [1992] framework rather than using another existing uncertainty measurement instrument. The application of Miller's framework facilitates partial comparisons with previous research projects (e.g. Chen [1995]; Haka [1987]) to confirm the reliability of the instrument used.

The measurement instrument on uncertainty includes the following items (the numbers between brackets refer to the number of the question in the survey; see *Appendix 4.1*):

- *General uncertainty (12):* this part includes questions on political uncertainty, policy uncertainty, macroeconomic uncertainty (exchange rates, interest, inflation, and other macroeconomic factors to be provided by respondents), social uncertainty and natural uncertainty;
- *Industry uncertainty (13):* industry uncertainties include input-market uncertainty, output market uncertainty and competitive uncertainty;
- *Organizational uncertainty (14):* these include labor uncertainty, input uncertainty, production uncertainty, liability uncertainty, R&D-uncertainty, credit uncertainty and behavioral uncertainty.

In addition to these pre-structured uncertainties, respondents are also given the opportunity to provide other uncertainties relevant to them; they have been asked to elaborate on these additional uncertainties. Likert-type questions on a 5-point scale are used to assess the impact of the uncertainties upon the projected results of the organization.

4.3.3 Other Contingency Factors

Several authors have developed and used instruments to measure some of the other contingency factors considered relevant to this study. Most of the other contingency factors relevant for this study have been measured by single-item questions. The inclusion of multi-item questions has been considered impossible, since a lengthy questionnaire reduces the response rate (Wallace & Mellor [1988]). The inclusion of single-item measures means that the reliability of the measurement instrument may sometimes be questionable: deriving reliability from answers to other questions provided by the respondents is not possible (Wallace & Mellor [1988]). Considering the explorative nature of this study (Segers [1980]), the reliability problems mentioned previously are not considered problematic. In addition, comparisons with other research projects on these variables are provided to enhance the credibility of the results of this study. The measurement instrument includes the following items:

- *Environment (8):* The environment is measured by two main dimensions, the level of dynamism and the level of complexity. The dimensions identified by Duncan [1972] and Waterhouse & Tiessen [1978] have been operationalized. Respondents have been asked to indicate how they would characterize the environment in which their organization is operating: static and simple, static and complex, dynamic and simple or dynamic and complex.
- *Technology (9):* Technology is measured by the degree of turbulence; the dimensions identified by Ansoff & McDonnell [1990] have been operationalized. Respondents have been asked to characterize the technology in their industry as:
  - *Stable/long-lived*: all organizations within the industry use similar technologies;
  - *Fertile*: technology offers the organization a chance to distinguish itself from others in the industry, but the technology does not change rigorously;
  - *Turbulent*: technology differs among organizations in the industry and is developing fast, or;
  - *Other*: the technology does not fit in the description provided previously.
- *Goals and objectives (21):* The goals and objectives of an organization are measured similar to Govindarajan & Gupta [1985]. The objectives included in the survey are operating profits/profit margins, cash flow, shareholder value/dividends, cost reduction, sales growth, market share, development of new markets/products, R&D, quality &customer/public value, personnel development/human resources, political/public effects and ethical performance. Respondents have been asked to identify the importance of these goals on a Likert-scale.
- *Corporate strategy (10):* corporate strategy is measured by the operationalization of the structure of the organization (Bossert [1993]; Anthony et al [1992]). Respondents have been asked to characterize their organization as either:

- (part of) a single business operation;
- (part of) a related diversified operation;
- (part of) an unrelated diversified operation.
- Another organization structure.

- *Business unit strategy (11)*: business unit strategy is operationalized similar to Gupta & Govindarajan [1985]. Instead of using continuous scales of a Guttman type (percentages), this study has asked respondents to indicate which of the following business strategies their organization pursues:
  - *Build strategy:* an increase of market share is more important than (short term) profits and cash flows;
  - *Hold strategy:* protection of market share and competitive position;
  - *Harvest strategy:* maximization of (short term) profits and cash flows is more important than market share;
  - *Divest strategy:* the organization is withdrawing from the activity.
- *Investment strategy (20):* for the purposes of this study, the investment strategy framework by Collis [1992] is operationalized. Organizations have been asked to indicate which of the following investment strategies best describes the investment strategy of their organization:
  - *Insurance:* early investment in large range of projects that, under al circumstances, as a whole provide a profit to the organization;
  - *Dedicated:* early investment in a small range of projects associated with a specific strategy;
  - *Incremental:* late investment in a small range of projects; investments are made when it is absolutely necessary to implement a specific strategy or when specific uncertainties are resolved;
  - *Opportunistic:* late investment in a large range of projects, adjustments of strategy are possible to take advantage of specific opportunities in the market.
- *Size (4, 5, 6):* size is measured by total assets, number of employees (in full time equivalents, fte's) and sales over 1996. Similar measures have also been used by other capital budgeting researchers (Ho [1992]; Klammer et al [1991]; Haka et al [1985]).
- *Industry (3):* industry is measured by the first two digits of the SIC-codes of the CBS. The industry code has also been used by other capital budgeting researchers (Ho [1992]; Haka et al [1985]). Respondents have been asked to provide the first two digits of their SIC-code.

4.3.4 Performance

A performance measure needs to be defined to determine whether the application of advanced capital budgeting practice results in better performance in specific situations. It is recognized that "performance" is itself an ambiguous term, and capable of no simple definition. In particular, the term does not specify to whom the organization is delivering its "performance" (Otley [1999]). To gain better insights into the findings and to ensure credibility, five different performances measures have been used. Four of these performance measures are objective, ex post, financial performance measures; one is a subjective, (partially) ex ante non-financial performance measure. There are both theoretical as well as practical reasons for the selection of these performance measures:

- First of all, the definition of organizations in this research project is such that it includes organizations that are not listed (individually) on public stock exchanges.
  Among the respondents are privately held corporations, (some) government and non-profit organizations, medium-sized firms, and subsidiaries of large organizations. A comparison of developments in the price of common stock of the respondents is therefore not possible.
- Second, a comparison of performance based on one financial performance measure (for example, ROA or ROE) may result in a distortion of results due to a limited number of extreme observations. A ranking based on one performance measure is thus not deemed appropriate, considering the ambiguity in profitability ratios (see Brealey & Myers [1988], p. 656). Also, financial performance measures alone may not capture the performance dimensions critical to the success of long-term investment decisions (Govindarajan & Gupta [1985]) since they are vulnerable to changes in accounting and finance decisions.
- Finally, the performance measure must "standardize" for uncertainty. That is, the financial performance of an organization has to be adjusted for the uncertainties inherent in (the projects of) the organization to see whether the performance represents superior or inferior performance (see Sharpe & Alexander [1990], p. 739). The reason is that if uncertainty and performance, as well as uncertainty and advanced capital budgeting practices, are correlated, a spurious relation between capital budgeting practices and performance may be measured. To prevent such a situation, the financial performance measures are adjusted for uncertainty.

The selected performance measures are discussed shortly.

Financial performance

Financial performance measures that have been used in previous research include stock price performance (Haka et al [1987]), return on assets (Chen [1995]; Klammer [1973]) and earnings performance (Ho [1992]; Kim [1982]). Within this research project, two non-adjusted financial performance measures have been selected: Return on Equity (ROE) and Return on Total Assets (ROA).

The REACH CD-ROM provides the data for ROA and ROE. The following definitions for ROA and ROE are used:

- *Return on Total Assets (ROA):* ROA is the ratio of income to total assets:

  ROA = EBIT / Total Assets

  The ROA seeks to measure the effectiveness with which the firm has employed its total resources. EBIT is defined as earnings from operations before interest and taxes. Total assets are defined as the sum of the book values of all assets present in the organization at the end of the year. The assets in a company's books are valued on the basis of their original cost, less any depreciation.
- *Return on Equity (ROE):* the ratio of net profit after taxes to equity measures the rate of return on the stockholders' investment:

  ROE = Net Income / Average Equity

  The ROE thus focuses on the return on the firm's equity. Net income is defined as the net income that is available to common stockholders. Since the equity of an organization is likely to change over the year, it is common to measure return on the average equity at the beginning and the end of the year. The ROE used in this research project is based on average equity.

Accounting principles and financial performance

It should be remembered that both ROA and ROE are vulnerable to (changes in) accounting principles and/or financing decisions. For the purposes of this research project, it is assumed that organizations apply similar accounting principles over the relevant evaluation period. The results for the individual organizations have not been adjusted to reduce the effects of different accounting principles or financing arrangements.

Evaluation period

Frequently, performance is evaluated over a time interval of at least four years, with returns measured for a number of periods within the interval – typically monthly or quarterly (see Sharpe & Alexander [1990], p. 734). In this research project, the evaluation period used to evaluate performance of the respondents is five years (from 1992 until 1996). Returns have been measured for each individual year. The reason that annual returns have been used is that quarterly or monthly return data are not available. The evaluation period covers the financial results of the organiza-

tions in the five years prior to sending the survey to the organization. The period of five years is somewhat arbitrary, but is related to the definition of investment projects used in the survey (respondents have been asked to indicate what capital budgeting practices have been used in the last two to three years and to use a time frame of five years to evaluate the impact of specific uncertainties on their investments; see *Appendix 4.1*). Also, the period of five years refers to the period that most organizations use to evaluate investments (see Carr & Tomkins [1996]). The implicit assumption is that none of the organizations has changed its' capital budgeting practices over this time period.

Adjusting performance for uncertainty

In this research project, the reward-to-variability ratio (also known as the Sharpe ratio) is used as an additional performance measure. Originally, the reward-to-variability measure has been designed to measure the performance of asset portfolios and mutual funds in comparison to the Capital Market Line (CML). The reward-to-variability ratio (RTVR) adjusts the performance of organizations for uncertainty. After some adjustments, the RTVR is also useful for the purposes of this research project. The RTVR uses total risk (measured by the standard deviation of the portfolio) as a measure of uncertainty[17].

Originally, the reward-to-variability ratio has been defined as (see Sharpe & Alexander [1990], p. 752):

$$\text{Reward-to-variability ratio} = [R_{jt} - R_{ft}] / \sigma_j,$$

Where: R_{jt} = the return of the jth mutual fund,
R_{ft} = the return on a risk-free asset (usually Treasury bills),
σ_j = the standard deviation of return on the jth mutual fund.

For the purposes of this research project, the average return and the standard deviation of the portfolio have been replaced by the average reward and the variability of the financial return of the organization:

$$\text{Reward-to-variability ratio ROA} = [ROA_j - R_f] / \sigma_{ROAj},$$
$$\text{Reward-to-variability ratio ROE} = [ROE_j - R_f] / \sigma_{ROEj}$$

Where: ROA_j, ROE_j = return on assets, respectively return on equity, of organization j;
σ_{ROAj}, σ_{ROEj} = variability of the ROA, respectively ROE, of organization j.

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17 Sharpe & Alexander [1990] state that total risk is the relevant measure of risk if the portfolio provides the sole measure of support for the investor. It is assumed that the organization can be regarded as a portfolio for management and other stakeholders such as employees: they depend on the organization for financial (wage) and non-financial (status) bonuses. Therefore, total risk is considered the appropriate uncertainty measure.

The RTVR corresponds to the slope of a line originating at the average risk free rate and going through a point having coordinates of (σ_{ROAj}, ROA), respectively (σ_{ROEj}, ROE). Since the ex post CML represents various combinations of risk-free lending or borrowing with investing in the market portfolio, it can be used to provide a benchmark for the RTVR. If the RTVR of an organization is greater than the slope of the ex post CML, it has outperformed the market. Alternatively, if the RTVR is below the ex post CML, the organization has not performed as well as the market.

Effectiveness

In addition to four objective performance measures, a subjective performance measure has also been used in this research project. The reason for the application of an additional subjective performance measure is that many performance dimensions of certain investment decisions (for instance, investments in new product development, market development and R&D) are not amendable to objective, quantitative measurement (see Govindarajan & Gupta [1985, 1984]; Govindarajan [1984]). Thus, the use of only objective performance measures (such as operating profits, cash flows and return on investment) to evaluate the performance of every organizational unit is not sufficient for the purposes of this research project. To gain better insights into the findings and to ensure reliability, an additional subjective performance measure has been used: organizational performance.

In utilizing a subjective approach to measure performance, it has been decided (1) to undertake performance measurement along a multiplicity of dimensions rather than on any single dimension, and (2) to weight the various performance dimensions in terms of their relative importance to the organization. Such a multivariate approach with criterion weights can be seen as particularly appropriate in a context where, by definition, different investment opportunities imply quite different sets of priorities (see Govindarajan & Gupta [1985], p. 655). Thus, effectiveness has been measured in the form of a comparison between actual performance and a-priori expectations rather than on an absolute scale.

Each respondent has been asked to rate each of twelve performance dimensions on a 5-point Likert scale, indicating the degree of importance attached by superiors to the performance of the organizational unit on that dimension. The twelve dimensions have also been used to measure the goals and objectives of the organization and include financial and non-financial criteria: operating profits/profit margins, cash flow, shareholder value/dividends, cost reduction, sales growth, market share, development of new markets/products, R&D, quality &customer/public value, personnel development/human resources, political/public effects and ethical per-

formance. Each respondent has also been asked to rate the performance of the organizational unit on each of the twelve dimensions compared to the expectations of superiors (question 22 in the survey). Again, a five-point Likert type scale (ranging from "not at all satisfactory" to "outstanding" has been used. Using the data on dimensional importance obtained in the first question as weights, a weighted average performance index was obtained for each organization.

4.4 Data Collection Methods

There are several potential data collection methods for research purposes (Bryman [1989], p. 30; Segers [1975], p. 146): self-administered questionnaires, structured interviews, participant observation, unstructured interviewing, structured observation, simulation and archival information. For this research project, data have been collected via self-administered questionnaires and archives (REACH CD-ROM, previous surveys).

For the field study part of this research project, anonymous pilot-tested questionnaires have been sent to chief financial officers of 704 large organizations in the Netherlands in May 1997. The names, addresses and telephone numbers of these organizations operating in the Netherlands have been drawn from the REACH CD-ROM database; in addition to that, the organizations have been phoned to solicit the name of the chief financial officer. After one month, all non-respondents have been contacted; if necessary, an additional questionnaire has been sent to them. The respondents could indicate in the survey whether they wanted to remain anonymous or provide their names or the names of their organization for additional information or receipt of the results.

4.4.1 Response rate

The data collection process has resulted in 220 responses from the 704 organizations in the target group (gross response rate of 31.3%). Out of these 220 respondents, 31 organizations (4.4%) have responded with non-participation. Reasons for non-participation include "survey-fatigue" (several organizations receive a large number of surveys each week) and lack of capacity at the financial group to answer the survey. The remaining 189 surveys are (at least partially) useable for the purposes of this study (an actual response rate of 26.9%). The response rate is in accordance with similar recent studies on this subject (Cotton & Schinski [1999]; Herst et al [1998]; Slagmulder et al [1995]). Eventually, more than a quarter of the target population has decided to participate in the research sub-project. Almost two thirds

of the participants (62.7%) and a fifth of the target population (19.6%) is interested in the results of the survey. The results from the data collection process are presented in table 4.1.

	Absolute numbers	Percentage related to target population	Percentage related to returned surveys
Target group	704	100.0%	NA
Total number of surveys returned	220	31.3%	100.0%
Non-participants	31	4.4%	14.1%
Participants	189	26.9%	85.9%
Participants, interested in results	138	19.6%	62.7%

Table 4.1: *Results data collection process*

4.4.2 Industry

The survey response is compared to data on enterprises by activity and size from the Dutch Central Agency for Statistics (CBS). This comparison may indicate whether the survey results are representative for large organizations in the Netherlands. The next table provides an overview of the classification of the respondents and the CBS-data on enterprises with more than 500 employees.

Industry-code	Industry	CBS data [A]			Survey participants [B]	
		In numbers	In % [C]	In %[D]	In %	In numbers
A	Agriculture and forestry	0	0.0%	0.0%	0.5%	1
B	Fishing	0	0.0%	0.0%	0.0%	0
C	Mining & processing	0	0.0%	0.0%	1.1%	2
D	Manufacturing	245	21.7%	38.0%	41.7%	78
E	Public utilities	26	2.3%	4.0%	7.5%	14
F	Construction & building	43	3.8%	6.7%	4.3%	8
G	Wholesale & resale trade	106	9.4%	16.4%	10.2%	19
H	Hotel & Catering	15	1.3%	2.3%	0.0%	0
I	Transport & communication	45	4.0%	7.0%	6.4%	12
J	Finance & Insurance	40	3.6%	6.2%	13.4%	25
K	Leasing & professional services	125	11.1%	19.4%	8.6%	16
L	Government, non-profit and other services	485	42.9%		6.4%	12
	Total	1130	100.0%	100.0%	100.0%	187
	Not classified					2
	Total participants					189

[A]: CBS data on enterprises by activity and size-class, 1 Jan 1997, SBI 93[18]
[B]: Data on survey respondents from research sub-project;
[C]: Including government, non-profit and other services industry;
[D]: Excluding government, non-profit and other services industry.

Table 4.2: *Responses by industry*

Table 4.2 reveals that the target population is oriented on business activities: firms are overrepresented, while the government and non-profit sector is underrepresented (survey: 6.4%, CBS: 42.9%).

This research project is focused on capital budgeting practices. There are industries where organizations in general have relatively low fixed assets and, therefore, have relatively few investments each year (trade, professional organizations). It is expected that these organizations invest relatively little and do not use sophisticated capital budgeting practices intensively (Segelod [1998], p. 209). The response from

18 Source: CBS publication "Bedrijven in Nederland", 1997.

these organizations is likely to be relatively low compared to the number of organizations in the target population. On the other hand, organizations that have high amounts of fixed assets are expected to rely heavily on their capital budgeting practices (for example, steel, petrochemical, building and construction industry). The response of these organizations is likely to be relatively high compared to the number of organizations in the target population. The survey data confirm this expectation: industries with relatively low fixed assets are slightly underrepresented (hotel & catering, survey: 0.0%, CBS: 1.3%; leasing & professional services, survey: 8.6%, CBS: 11.1%), while (some) industries with a relatively high amount of fixed assets are overrepresented (manufacturing, survey: 41.7%, CBS: 21.7%; public utilities, survey: 7.5%, CBS: 2.3%).

Another interesting observation is the relatively high participation of the finance and insurance industry (survey: 13.4%, CBS: 3.6%). The overrepresentation of the financial industry may stem from a combination of factors. First, banks and insurance companies generally have relatively high amounts of fixed financial assets in their portfolios relative to other organizations. Second, the financial industry relies heavily on large complicated information systems. It is possible that financial institutions have developed capital budgeting procedures to secure sound investments in both fixed financial assets as well as in information systems.
Both factors may have led to an overrepresentation of financial institutions in the survey participants (survey: 13.4%, CBS: 3.6%).

From a comparison of survey participants and CBS data on industry and size-class, it is concluded that manufacturing, public utilities and finance & insurance industries are overrepresented in the survey. The government, non-profit and other services industries are underrepresented in the survey; in general, the service industry (leasing and professional services, hotel & catering) seems slightly underrepresented in this research sub-project. Therefore, the survey seems biased towards business organizations that rely quite heavily on fixed assets. Extrapolation of the results of this analysis to smaller firms or "pure" non-profit organizations (i.e., organizations that dispose of their products other than for payment) should not be attempted.

4.4.3 Size

The survey contains three criteria for the size of the organization: the number of employees (fte's) total asset size and total sales (over 1996). The next table gives an indication of the size of the participating organizations with respect to these criteria.

Size of Participating Organizations	Response (in %)
Number of Employees	
• up to 500 fte	26.6%
• 500 fte up to 1,500 fte	39.9%
• 1,500 fte up to 5000 fte	21.3%
• more than 5,000 fte	12.2%
Asset Size	
• up to *f* 100 million	21.8%
• *f* 100 million up to *f* 500 million	40.8%
• *f* 500 million up to *f* 2 billion	19.5%
• more than *f* 2 billion	17.9%
Sales	
• up to *f* 100 million	11.3%
• *f* 100 million up to *f* 500 million	42.9%
• *f* 500 million up to *f* 2 billion	27.2%
• more than *f* 2 billion	18.6%

Table 4.3: *Responses by size*

The "average organization" participating in this research project has 500 to 5.000 employees, total assets ranging from *f* 100 million (about € 45 mln) to *f* 2 billion (about € 900 mln) and sales from *f* 100 million (€ 45 mln) to *f* 2 billion (€ 900 mln). Therefore, the research project may involve some smaller organizations but mainly reflects the capital budgeting practices of large organizations. Also, it has to be considered that the smaller participating organizational units are part of larger organizations and, therefore, will be influenced by the capital budgeting framework of the parent organization.

4.4.4 Respondents

The survey has also collected some "demographic information" on the respondents, including their function or job title in the organization and the number of year's experience in their current position. The next table gives an overview of the respondents.

Demographics on Respondents	Response (in %)
Function/Job Title	
• General management	3.7%
• Financial officer/director	39.2%
• Controller	42.3%
• Treasurer	2.6%
• Financial employees/business analysts	5.3%
• Others	6.8%
Number of Years Experience in Current Position	
• 1 to 3 years	36.7%
• 3 to 6 years	30.9%
• more than 6 years	32.4%

Table 4.4: *Characteristics of respondents*

The table reveals that about 40% of the respondents is the financial officer/director of the participating organization, while another 40% of the respondents operates as a controller (either corporate controller or assistant controller) in the organization. Other respondents include general managers (3.7%), treasurers (2.6%) and other financial employees. Finally, the category "Other respondents" (6.8%) includes members of the capital budgeting committee, purchasing managers, financial engineers and directors corporate planning & control. The survey also indicates that the majority of respondents has been in this position for more than 3 years. On average, the respondents have more than 5 years of experience in their current position. Considering the background of the respondents (mostly finance and accounting) and the number of years in their current position, it is expected that they are well informed on the capital budgeting practices of their organization.

4.4.5 Nonresponse Bias

A number of tests were conducted to ensure the nonresponse bias for the sample (Wallace & Mellor [1988]). First, the measures for the application of six capital budgeting techniques from the first 40 questionnaires received were compared with the results of the last 40 questionnaires in order to check for any possible bias. This technique indicated no significant difference ($\alpha>0.05$) between early and late responding organizations. Additionally, two financial variables (sales and asset size) and one personnel variable (number of employees) for early and late respondents were compared. Again, no significant difference ($\alpha>0.05$) was found between early and late responding organizations. Since not all-financial data from the target population are not always publicly available, it was not possible to compare the financial and personnel variables of the participants to the similar measures of the to-

tal target population. However, the tests on the participants suggest that nonresponse bias was minimal in the data collected.

4.5 Conclusion

In this study, the relationship(s) between capital budgeting practices, uncertainties, contingencies and performance of organizations are investigated. The organizations in the sample are large business (like) organizations in the Netherlands, that are responsible for revenues and costs and have (at least some) discretion over capital budgeting practices. The previous selection criteria, as well as the questions regarding capital budgeting practices, are similar to other research projects on capital budgeting. Uncertainty is measured by the operationalization of Miller's [1992] uncertainty framework. The contingencies are measured by several questions drawn from other research projects or by operationalizing theoretical concepts provided by literature. Performance is measured by the instrument that Govindarajan & Gupta [1985] introduced into literature as well as by financial performance measures drawn from the REACH CD-ROM database.

The respondents to the survey are typically financial executives/directors and controllers of the organizations, (which is in accordance with objectives). To select the organizations, three criteria have been used: (1) sales have to exceed *f* 60 million (€ 27 mln), (2) total assets have to exceed *f* 45 million (€20 mln) and (3) costs for personnel have to exceed *f* 35 million (€16 mln). With an actual response rate of almost 27%, the participation of organizations in the survey research project can be qualified as average to good. From an analysis of the industry, it is concluded that the government/non-profit and the service industry are underrepresented, while manufacturing, public utilities and finance & insurance are overrepresented. When the size of the responding organizations is taken into account, it becomes clear that indeed mostly large organizations have participated in the research project. Finally, a number of tests on the nonresponse bias indicate that there is no bias towards early or late respondents; thus, these tests suggest that the nonresponse bias was minimal in the data collected.

CHAPTER 5

CAPITAL BUDGETING PRACTICES AND DECISION MAKING

5.1 Introduction

In previous chapters, the theoretical and methodological foundations for this research project have been discussed. In this chapter, the empirical results on (determinants of) capital budgeting decision practices are provided. The results presented in this chapter are based on the responses to the survey presented in the previous chapter.

Capital Budgeting Practices in the Netherlands

The current observations are compared to the findings of previous surveys in the Netherlands. The next table provides some of the characteristics of reference studies on capital budgeting practices in the Netherlands in the last 25 years.

Study	Research Population	Size characteristics of organizations	Industries
Herst et al [1998]	44 small, medium and large firms out of sample of 210 firms	Sample: 10-22,000 fte (32% 1,000-10,000 fte); investment budget of sample: ƒ 300,000 (€130,000) - ƒ 4 billion (€1.8 billion)	Natural gas, dredging, chemics, food, consumer products, service
Nieman [1985]	9 large firms	Unknown	Retail, manufacturing
Hoogstraten [1982]	74 small, medium and large firms	10 firms 0-100 fte; 25 firms 100-500 fte; 39 firms > 500 fte.	Manufacturing
Van Geuns & Verhagen [1981]	5 large, divisionalized firms	Unknown	Unknown
Van Dam [1978]	33 large firms	Unknown	Retail, manufacturing, service

Fte : full time equivalent.

Table 5.1: *Previous surveys on capital budgeting practices in the Netherlands*

Table 5.1 reveals that most information on capital budgeting practices in the Netherlands is based on (fairly) small samples in large organizations (with the exception

of the research by Herst et al [1998] and Hoogstraten [1982]). The previous surveys may differ from this study in research population (other industries), sample size (larger in this study), wording of the questions and analysis methods. These limitations should be observed when drawing conclusions regarding a change in capital budgeting practices in the Netherlands.

Capital Budgeting Practices in other Western Countries

In addition to a comparison to previous research projects on Dutch capital budgeting practices, the findings in this study are also compared to the survey results from other Western countries. The next table provides some characteristics on (relatively) current capital budgeting surveys in other Western countries over the last 10 years.

Study	Target population	Response rate	Size of organizations	Country
Cotton & Schinski [1999]	500 small & medium manufacturing firms (investments in CIM)	16%	Sales $1.6 mln-$1.3 bln; Total assets $ 1 mln-$1.8 bln (median total assets: $15 mln)	USA
Herst et al [1998]	210 small, medium and large firms	21%	10-220,000 employees; Investment budgets (*f* mln): 0.3-4,000	Netherlands
Van Cauwenbergh et al [1996]	73 firms; unknown number of banks	58% (42 firms) Banks: 18 responses	Sales > BF 3 billion; Employees > 200; Limited liability company; NACE-code: 1-7.	Belgium
Ho & Pike [1996; 1991]	Largest 350 firms in TIMES 1000, defined by sales	43%	Fixed assets (£ mln): 0-50:38%; 50-200: 23%; 200-500: 18%; >500: 21%.	UK
Slagmulder et al [1995]	200 European firms that recently invested in CIM	20%	Investment projects (ECU) Average 5 mln ; Range 50,000-42 mln	Europe
Chen [1995]	599 publicly held manufacturing firms	20%	Large manufacturing firms (specification unknown)	USA
Sangster [1993]	491 companies of Scotland's Top 500 companies	22%	Turnover £ 5 mln - £ 2 bln; number of employees 18 - 41,000	UK
Kamath & Oberst [1992]	427 hospitals	22%	Average Cap.Budget ($mln): 2.8 (13%)-20.2 (15%)	USA
Wilner et al [1992]; Klammer et al [1991]	500 large industrial companies	20%	Capital expenditures > US$ 20 mln	USA

Table 5.2: *Current capital budgeting practices in Western Countries*

Table 5.2 reveals that the surveys in other countries seem to be fairly similar to the survey in this study, both with regard to sample size and research population (although some surveys are biased towards manufacturing firms). The credibility of

the results obtained in this study may be enhanced if they are similar to the findings of (recent) surveys in other countries. Also, this comparison may provide an indication for the generalizability of the findings of the current research project to other research settings.

Previous Research on Determinants of Capital Budgeting Practices

The focus of this chapter is on the relationships between uncertainty, other contingency factors and capital budgeting practices. The results in this study will be compared to the results from other research projects, most of which are presented in the next table.

Study	Variable of interest	Determinants relevant to this study	Other factors investigated	Method
Slagmulder [1997]	Investment decisions	Strategy	Environment, information asymmetry, uncertainty, strategic misalignment, adaptation of MIS	Case studies (10)
Pike [1996]	Capital budgeting practices	Size	Planning & control procedures	Survey
Chen [1995]	Capital budgeting decision rule	Objectives, uncertainty, strategy, size	Compensation of CEO, product diversification, performance, debt structure	Survey, public data sources
Lillis [1992]	Capital expenditure decision	Performance measures, long term plan	Locus of control, familiarity, management service history	Case studies (3)
Kamath & Oberst [1992]	Capital budgeting decision rule	Size	Ownership, region	Survey, public data sources
Klammer et al [1991]	Capital budgeting practices	Size, performance		Survey, public data sources
Haka [1987]	Capital budgeting decision rule	Strategy, environment	Information system, reward structure, decentralization	Survey, public data sources
Kim [1982]	Capital budgeting practices	Performance, risk, size	Debt ratio	Survey, public data sources

Table 5.3: *Previous studies on determinants of capital budgeting practices*

Data Analysis

Among the relevant data analysis methods used in this study are factor analysis (principal component analysis), correlation analyses, comparison of means (Anova-test), and several non-parametric tests. The factor analysis tables either reveal the component matrix or the table for explanation of total variance. For the analysis of potential determinants of capital budgeting practices, the data are mostly presented in k-r tables.

Generally, the Kruskal-Wallis test has been used to test the hypotheses (see Siegel [1956], p. 184); the results of the Kruskal-Wallis test are generally verified by the application of the χ^2-test and the Mann-Whitney U test. Finally, the correlation analyses present the Pearson correlation coefficients in the tables; the Pearson correlation results are verified by a comparison to the results of the Spearman and the Kendall correlation. The results of the additional tests are discussed only if there are differences between the "original tests" and the "verification tests".

Considering that this is an explorative research project, some variables are rearranged to evaluate their impact on capital budgeting practices. That is, variables are included in the analysis if there is only the slightest hint that they have an impact on investment decisions (either by the application of different tests or another classification of the variables). The inclusion of "vague" variables probably reduces the "descriptive" power of the model; however, inclusion is deemed necessary to derive a model that is as complete as possible. Additional research may reveal whether the variables are included rightfully or whether they have to be removed from the model.

Outline of the Chapter

The remainder of this chapter is structured as follows. The next section provides insight in the uncertainty identification and analysis techniques, uncertainty adjustment techniques and decision rules used by organizations in the capital budgeting selection process. In addition to that, the classification of organizations in the several categories (SRA-, PRA- and GOTA-users; see chapter 4 for definitions) is discussed. The relation between uncertainty and capital budgeting practices is discussed in the third section. In the next section, the impact of other contingencies on capital budgeting practices is evaluated. Some additional considerations with regard to the survey data are presented in the fifth section of this chapter. From the survey data, the "multiple contingency profile" for organization, is derived (see section 5.6). Finally, the last section of this chapter summarizes the results presented in this chapter.

5.2 Recognition of Capital Budgeting Practices

5.2.1 Uncertainty Identification

The first issue is how organizations identify the uncertainties enclosed in the project in screening investment projects. Organizations generally want to be aware of the uncertainties they accept when undertaking an investment. The next table provides an overview of the methods and techniques used to identify uncertainties in investment projects (see chapter 3 for a clarification of terms).

	1	2	3	4	5	mean
Checklists with potential losses for certain projects	21.5%	27.4%	26.3%	19.9%	4.8%	2.59
Analysis of future balance sheets and income statements	6.0%	7.6%	12.0%	57.1%	17.4%	3.72
Flow chart methods to identify uncertainties in processes	25.4%	33.0%	18.9%	19.5%	3.2%	2.42
On-site inspections at similar projects	14.6%	17.8%	32.4%	29.7%	5.4%	2.94
Interaction with other organizational units	7.6%	7.6%	18.4%	53.5%	13.0%	3.57
Interaction with outsiders	7.0%	12.9%	22.6%	46.8%	10.8%	3.41
Contract analysis	5.9%	5.4%	15.1%	54.3%	19.4%	3.76
Analysis of statistical records	14.1%	27.0%	27.6%	25.9%	5.4%	2.82
Analysis of the environment	6.5%	11.4%	26.6%	45.7%	9.8%	3.41

(1= unimportant, 2= fairly unimportant, 3= neutral, 4 = important, 5= very important)

Table 5.4: *Uncertainty identification techniques in capital budgeting projects*

Table 5.4 indicates that contract analysis, analysis of projected balance sheets and income statements and interactions with other organizational units are the most important uncertainty analysis techniques. Other techniques are considered less important uncertainty identification tools in the capital budgeting process. Some of these other methods (such as checklists with potential losses for certain projects, analysis of statistical records and flow chart methods) rely mostly on data and process information already available to the organization and may be considered "operational risk management tools" (see Williams & Heins [1989]).

There is hardly any information on uncertainty identification in the capital budgeting process, neither in the Netherlands nor in other Western countries. An evaluation of the trends in the application of these techniques is therefore not possible.

5.2.2 Uncertainty Analysis

Organizations can use a number of techniques to analyze the impact of the identified uncertainties on the investment project under consideration. The next table provides an indication of the importance of the uncertainty analysis techniques to the respondents (see chapter 3 for a clarification of terms).

	1	2	3	4	5	mean
Sensitivity analysis/break-even analysis	3.7%	8.0%	16.0%	56.9%	15.4%	3.72
Scenario analysis	5.9%	10.6%	19.7%	51.1%	12.8%	3.54
Monte Carlo simulations	60.6%	22.3%	12.2%	4.3%	0.5%	1.62
Decision trees	42.2%	28.9%	17.1%	10.7%	1.1%	1.99
CAPM analysis / ß analysis	49.5%	20.4%	14.5%	11.8%	3.8%	2.00

(1= unimportant, 2= fairly unimportant, 3= neutral, 4 = important, 5= very important)

Table 5.5: *Uncertainty analysis techniques in capital budgeting practices*

Table 5.5 reveals that sensitivity analysis/break-even analysis is the most important uncertainty analysis technique in the capital budgeting selection process (important to very important to 72% of the respondents). This "rating" is in accordance with recent trends in capital budgeting: previous research by Pike [1996] indicates that approximately 88% of the UK-firms uses sensitivity analysis (up from about 65% in the beginning of the 1990s; see Pike & Ho [1991]). The "rating" for sensitivity analysis in this survey is higher than the "application percentage" of 58% from the survey by Herst et al [1998]. There may be two reasons for the high "rating" in this research project. First of all, the passage of time[19] may have resulted in the fact that more organizations apply uncertainty analysis in the investment decision. Ho & Pike [1991] noted that the use of uncertainty analysis was expected to increase due to the growing application of microcomputers and associated uncertainty analysis software. The second reason is that this survey focused on larger organizations, while the survey by Herst et al [1998] included small and medium-sized as well as large organizations. Research has indicated that larger organizations tend to use more sophisticated capital budgeting methods (especially uncertainty analysis methods) than smaller organizations do (see Pike [1996]; Schall & Sundem [1980]).

Scenario analysis is another important uncertainty analysis technique used by the responding organizations in this research project: about 64% rates this technique as important or very important. These results are in concordance with the results from a survey by Slagmulder et al, [1995], who found that nearly 60% of the organizations used (cash flow) scenario analysis. Other more advanced uncertainty analysis techniques, although highly developed in theory, have not been widely accepted by practitioners. Monte Carlo simulations, decision trees and CAPM/β analysis are hardly important to the respondents. These research results are similar to the results from studies by Pike [1996] and Pike & Ho [1991] among UK-firms and to the results from a study by Klammer et al [1991] on American firms. Compared to the previous studies, however, the application of CAPM/β analysis is (slightly)

[19] The survey by Herst et al [1998] was held at the end of 1995 and the beginning of 1996. The survey for this study was sent to organizations in the summer of 1997.

higher in this research project; this may result from the growing interest in Economic Value Added (EVA) techniques.

There is little information on the application of uncertainty analysis techniques in the Netherlands. Nieman [1985] found that 67% of the organizations used sensitivity analysis to analyze uncertainty in capital budgeting projects. Van Geuns & Verhaegen [1981] observed that "uncertainty analysis is always additional, at the last stage of the decision process". Based on this scattered information, it is expected that the application of uncertainty analysis techniques in the Netherlands has increased over time (or, at least, has not decreased), just as it has in other Western countries. However, the evidence for this increase is not overwhelming.

5.2.3 Adjustments for Uncertainty

Organizations can apply several methods to adjust the investment project under consideration for the uncertainty inherent in it. The next table gives an indication for the ways organizations account for uncertainty in the investment decision (see chapter 3 for a clarification of terms).

	1	2	3	4	5	mean
Adaptation of required payback period	26.7%	19.3%	32.1%	16.6%	5.3%	2.55
Adaptation of required return/discount rate	20.9%	16.0%	34.8%	20.3%	8.0%	2.79
Uncertainty absorption in cash flows	30.5%	19.3%	33.2%	12.8%	4.3%	2.41
Adjusting expected values	42.0%	19.7%	23.9%	11.7%	2.7%	2.13
Using certainty equivalents	62.8%	20.7%	10.6%	3.7%	2.1%	1.62

(1= never, 2= rarely, 3= sometimes, 4= often, 5= always)

Table 5.6: *Adjustments for Uncertainty in the Capital Budgeting Process*

Table 5.6 reveals that the adaptation of the required rate of return and the required payback period are used most often to adjust for uncertainty in the investment project under consideration. Other methods are used relatively infrequent. The results are in concordance with the results from other recent studies on capital budgeting practices (see, for example, Herst et al [1998]; Pike [1996]; Klammer et al [1991]).

At least a (fairly large) minority of the organizations does not explicitly adjust for uncertainty in the investment decision on a structural basis[20]. This conclusion is supported by research by Slagmulder et al [1995], which found that a fairly large fraction of organizations in their research project (45%) did not use any formal

[20] The summation of the percentages of organizations that use the techniques "often" or "always" results in a score of 87%. Therefore, at least 13% of the organizations does not adjust for uncertainty on a regular basis.

method for incorporating the uncertainty element into the investment appraisal. Similarly, Kamath & Oberst [1992] found that only 36% of their respondents accounted for uncertainty in the investment decision. This suggests that these organizations use a "two-step procedure" for capital budgeting. First, uncertainties are identified and analyzed; the most horrendous projects (i.e., projects that may result in discontinuity to the organization) are excluded from further analysis. From the acceptable projects, the most profitable project or the one with the highest (expected) NPV is selected. It should be noticed that this procedure might result in the selection of profitable projects which yield (highly) uncertain returns (see Northcott [1992]).

There is hardly any information from previous research projects on how organizations in the Netherlands adjust for uncertainty in the investment decision. Therefore, it is hard to verify whether the trends observed in other countries also manifest themselves in the Netherlands.

5.2.4 Capital Budgeting Decision Rules

This section deals with the capital budgeting selection rules used by organizations. The application of selection rules is not mutually exclusive; many organizations use a combination of them (see, for example, Herst et al [1998]; Pike [1996]; Sangster [1993]; Van Dam [1978]). The next table provides an indication to what extent organizations use different capital budgeting selection rules.

	1	2	3	4	5	mean
Payback period (PB)	5.8%	7.4%	18.0%	37.0%	31.7%	3.81
Accounting rate of return (ARR)	27.0%	21.2%	19.0%	19.0%	13.8%	2.71
Profitability index (PI)	35.1%	19.1%	22.3%	13.8%	9.6%	2.44
Internal rate of return (IRR)	19.0%	14.3%	20.6%	23.8%	22.2%	3.16
Net present value (NPV)	6.9%	6.9%	22.2%	31.7%	32.3%	3.76
Real option pricing (ROPT)	59.9%	20.3%	14.4%	3.7%	1.6%	1.67
Game theory decision rules (GTDR)	70.7%	17.6%	6.4%	3.2%	2.1%	1.48

(1= never, 2= rarely, 3= sometimes, 4= often, 5= always)

Table 5.7: *Capital Budgeting Selection Rules*

Previous table indicates that the payback method, the net present value method and the internal rate of return are used most frequently by organizations. Accounting selection techniques, such as accounting rate of return and the profitability index are utilised not as regularly. The more advanced capital budgeting selection techniques (real option pricing theory, game theory decision rules) are hardly used

at all by the respondents. The results of this research project are similar to results from current research by Herst et al [1998], Chen [1995] and Klammer et al [1991].

The survey results of the 10 respondents that indicated that they use ROPT methods "often" or "always" have been analyzed in more detail to gather more information regarding the specific characteristics of these organizations. Two out of these ten firms operate in the mining & processing industry; the respondents are the Dutch branches of large international mining firms. Three firms are active in the financial services industry and are (part of) large, internationally operating banks and/or insurance companies. The application of ROPT in these firms is not surprising, considering the fact that these two branches appear to be most familiar with option pricing (see, for example, Stern & Chew [1992]; Smith et al [1990]). Two firms operate in the other services industry; these are fairly large firms, but the survey does not reveal the exact nature of their activities. One firm that uses ROPT methods on a regular basis is the Dutch branch of a foreign, internationally operating food company (more than 2,000 employees in the Netherlands; total number of employees of the firm is unknown). One organization is active in the building & construction branch; additional data are missing, but it is possible that the organization takes active positions in project development and/or turnkey projects. Finally, the last firm is active in transport; this is a rather small firm compared to the other organizations. From these results, it appears that the majority of the respondents that uses ROPT on a regular basis (6 out of 8) may be considered "top of their class"; these organizations are (part of) large, internationally operating firms. These characteristics (large, international, and "top of their class") may explain why they use the ROPT-methods on a regular basis.

Five out of the ten ROPT-users could be identified and were contacted to answer additional questions regarding the application of ROPT. The international food company responded favorably to this request. It appears that it uses ROPT mostly for expansion investments in new markets (new operations). To a lesser extent, ROPT-methods were used to evaluate expansion investments for existing operations, for general and administrative investments and for high technology investments. Other investments (replacement, social expenditures, foreign operations and abandonments) were either not evaluated by ROPT-methods or not relevant. In addition, ROPT-methods were mainly used to evaluate the acquisition of (parts of) other firms, mergers and (to a lesser extent) R&D projects. Investments in financial assets, e-business and software, patents or test plants are not evaluated by ROPT-methods. The firm does not use any special software for the ROPT-evaluations. Finally, the necessary data are gathered by market research as well as by estimates from management, finance department, other departments (marketing, production)

and/or outsiders (lawyers, market researchers, etc.). In addition to that, the company mentioned in the articles by Lint & Pennings [1997;1998] has been contacted. The company responded that it does not use ROPT on a structural basis due to the difficulties associated with the estimates necessary for the ROPT-method. Concluding, ROPT-methods appear to be most useful to evaluate expansion investments (especially new markets) and/or new production technologies. Also, the acquisition of other firms and R&D-projects may be evaluated using ROPT-methods. The difficulties of obtaining the necessary data and the complexity of ROPT appear to be hurdles in the application of ROPT.

Respondents were given the opportunity to indicate if they used non-financial or other decision rules in the capital budgeting decision. The most frequently listed non-financial decision rules are market share (important or very important to 25% of the respondents), the strategy of the organization (14%), developments on the output market (6.8%), quality requirements regarding output (3.2%) and environmental demands (1.6%). These results indicate that strategic and market demands are considered explicitly in the capital budgeting decision, even though they are not reflected in the financial capital budgeting selection rules.

The next table provides some information on trends in capital budgeting selection rules in the Netherlands[21].

Author	Van Dam [1978]	Hoogstraten [1982]	Nieman [1985]	Current study
Number of organizations participating in the study	N=33	N=74	N=9	N=189
Payback period	61%	84%	100%	69%
Accounting rate of return	64%	30%	11%	33%
Profitability index	9%	NA	11%	23%
Internal rate of return	48%	20%	67%	46%
Net present value	58%	12%	33%	64%

NA = not available.

Table 5.8: *Developments in capital budgeting decision rules in the Netherlands*

The previous table does not provide a clear picture on the trends in capital budgeting decision rules. This is due to the fact that the surveys are drawn from different populations and are different in size. These differences make it difficult to draw any "hard" conclusions from the presented data (see also Pike [1996]). The importance of the discounted cash flow methods (IRR, NPV) seems to have (at least) stabilized

[21] The classification used by Herst et al [1998] does not provide the information necessary to derive the previous statistics; therefore, their survey is not included in the table.

(and potentially increased) in the Netherlands. The constant (or increased) popularity of the discounted cash flow methods seems to be accompanied by a decrease in the popularity of the accounting rate of return since the midst of the 1970s. The payback method has remained very popular in the Netherlands over the last 25 years. The developments in the Netherlands are quite similar to the trends observed in capital budgeting selection rules in other Western countries (Pike [1996]; Sangster [1993]; Klammer et al [1991]).

5.2.5 Classification of Respondents

The responses on uncertainty identification, uncertainty analysis, adjustments for uncertainty and capital budgeting selection rules have been used to provide a basis for the classification of respondents. However, the results indicate that 96% of the respondents lists at least one of the uncertainty identification techniques as (very) important; in addition to that, the remaining 4% uses a combination of techniques to identify uncertainty in the capital budgeting process. Therefore, uncertainty identification is not considered a discerning criterion in the classification process. The other three steps in the capital budgeting process are considered to be discerning criteria; each of them is discussed shortly.

Classification on Uncertainty Analysis

The first classification criterion is based on the structural application of uncertainty analysis techniques used by the respondents. The following criteria are used to classify organizations:

1. Organizations qualify as "uncertainty analysis user" if they indicate that sensitivity analysis, scenario analysis, Monte Carlo simulations, decision trees or CAPM-analysis are used "often" or "always".
2. Organizations are qualified as "non-uncertainty analysis user" if they indicate that neither of the previously listed techniques is used "often" or "always".

The next table gives an indication of the frequency distribution of uncertainty-analysis users and non-uncertainty analysis users.

Classification of Responding Organizations	Percentage of Organizations
Uncertainty analysis users	83.5%
Non-uncertainty analysis users	16.5%
Total	100.0%

Table 5.9: *Classification of responding organizations, based on uncertainty analysis techniques*

Classification on Uncertainty Adjustments

The second step in the classification of organizations is based on how organizations adjust the project for uncertainties in the investment decision. The following classification scheme is developed:

1. Organizations qualify as "uncertainty adjuster" if they indicate that one of the uncertainty adjustment methods is used "often" or "always".
2. Organizations are qualified as "non-uncertainty adjuster" if they indicate that neither of the previously listed techniques is used "often" or "always".

The next table gives an indication of the frequency distribution of uncertainty adjusters and non-uncertainty adjusters.

Classification of Responding Organizations	Percentage of Organizations
Uncertainty adjusters	54.0%
Non-uncertainty adjusters	46.0%
Total	100.0%

Table 5.10: *Classification or responding organizations, based on uncertainty adjustments*

Classification on Capital Budgeting Selection Techniques

The third step in the qualification process distinguishes between organizations that apply accounting decision rules and organizations that apply uncertainty decision rules. The next criteria have been used to classify organizations:

1. Organizations qualify as "uncertainty decision user" only if they indicate that real option pricing techniques or game theory decision rules are used "often" or "always". It is also possible that they use other accounting decision- or risk decision-techniques.
2. Organizations are qualified as "risk decision user" if they indicate that either discounted cash flow techniques or internal rate of return techniques are used "often" or "always". Risk decision-users can apply "accounting decision-techniques", but do not frequently use the "uncertainty decision-techniques".
3. Organizations are classified as "accounting decision-user" if they indicate that they do not meet any of the previous criteria to qualify as either "risk decision-" or "uncertainty decision-users".

The next table gives an indication of the frequency distribution of accounting decision-users, risk decision-users and uncertainty decision-users.

Classification of Responding Organizations	Percentage of Organizations
Accounting decision users	23.8%
Risk decision users	67.7%
Uncertainty decision users	8.5%
Total	100.0%

Table 5.11: *Classification or respondents based on capital budgeting selection techniques*

Classification in SRA-, PRA- and GOTA-users

Finally, the previous classifications based on uncertainty analysis techniques, adjustments for uncertainty and capital budgeting selection techniques can be used for an "overall classification" of respondents. Considering the current state of information technology and software tools available to organizations, it is possible that organizations use discounted cash flow decision rules but apply standard discount rates. To determine a discount rate suitable for the project under consideration, an organization needs to determine what specific uncertainties are enclosed in the project and needs to take these uncertainties in account when making the investment decision.

The following criteria have been used:

- The term "Simple Risk Adjuster" (SRA) refers to organizations that use either accounting investment decision rules or risk decision rules, but do not use uncertainty analysis techniques nor uncertainty adjustment methods. Therefore, organizations that use discounted cash flow, real option pricing or game theory techniques but do not use uncertainty analysis and/or uncertainty adjustment techniques on a regular basis classify as SRA-user.
- The term "Probability Risk Adjuster" (PRA) refers to organizations that apply discounted cash flow decision rules (NPV, IRR) and use uncertainty analysis techniques and uncertainty adjustment methods on a regular basis.
- Finally, the term "Game/Option Theory Adjuster" (GOTA) refers to organizations that use uncertainty investment decision rules (ROPT, game theory) and apply uncertainty analysis techniques and uncertainty adjustment methods on a regular basis.

If organizations indicated that they apply several techniques, the most advanced technique employed was considered to be the dominant selection technique. This results in the following classification scheme:

Nr	Uncer-tainty analysis applied?	Accounting for risk/ uncer-tainty?	Investment decision rule?	Number of organizations	Percentage of Respondents	Classification
1	No	No	Accounting decision rule	11	5.9%	SRA
2	No	Yes		4	2.1%	SRA
3	Yes	No		21	11.2%	SRA
4	Yes	Yes		8	4.3%	SRA
5	No	No	Risk decision rule	8	4.3%	SRA
6	No	Yes		7	3.7%	SRA
7	Yes	No		43	22.9%	SRA
8	Yes	Yes		70	37.2%	PRA
9	No	No	Uncertainty decision rule	0	0.0%	-
10	No	Yes		1	0.5%	? (GOTA)
11	Yes	No		3	1.6%	? (GOTA)
12	Yes	Yes		12	6.4%	GOTA
			Total [N=188]	**188**	**100.0%**	

() = eventual classification.

Table 5.12: *Classification or responding organizations*

One of the respondents provided not enough information for the classification process; as a result, 188 respondents can be classified. Based on the classification criteria discussed previously, 54.3% of the respondents is classified as SRA-user (102 organizations). Another 37.2% of the respondents can be classified as PRA-users (70 organizations). The last group of organizations analyse what uncertainties are present in the investment project under consideration and adjust their projects for these uncertainties; also, they base their decision on a (discounted cash flow) decision rule that takes risk into account. Finally, 6.4% of the respondents (12 organizations) is fully compliant with the GOTA-criteria; another 2.1% of the respondents (4 organizations) is also classified as GOTA-user, even if they don't exactly match the criteria. Three of these organizations use more than one uncertainty adjustment technique, albeit not on a regular basis. The other organization relies on several uncertainty analysis techniques rather than on one to analyse the impact of uncertainty on the capital budgeting decision. Therefore, 8.5% of the respondents is classified as GOTA-user.

The classification scheme presented previously has been designed to measure whether organizations use a structured approach to deal with uncertainty in the capital budgeting process. It is also possible to measure the sophistication of capital budgeting practices by measuring how many methods and techniques are used fre-

quently by organizations. By summarising the scores[22] on the capital budgeting methods described in section 7.2, another measure for the sophistication of capital budgeting practices can be obtained. The next table provides some data on the relation between the number of techniques used to deal with uncertainty and the classification deride in the previous table.

Techniques used	SRA-user	PRA-user	GOTA-user	F	P
SRA-techniques used	17.62	20.91	22.15	22.58	0.000
PRA-techniques used	15.09	19.63	24.62	58.64	0.000
GOTA-techniques used	5.86	6.89	12.00	40.22	0.000
Total number of techniques used	38.72	47.28	58.77	56.66	0.000

The scores for each classification group are calculated by summarising the scores on the application of techniques:
SRA-techniques = Sensitivity/break-even analysis, scenario analysis, adaptation of payback period/required return, payback period, accounting rate of return (minimum score = 6, maximum score = 27);
PRA-techniques = Monte Carlo simulations, CAPM-/β-analysis, risk absorption in cash flows, adjusting expected values, profitability index, internal rate of return, net present value (min = 7, max = 31);
GOTA-techniques = Decision trees, certainty equivalents, real option pricing, game theory decision rules (min = 4, max = 18).
Total number of techniques used = sum of all scores on uncertainty analysis, adjustment and decision rules (min = 17, max = 75).

Table 5.13: *Relation between number of techniques and classification of respondents*

The correlation coefficient between the sum of scores the number of techniques used and the classification of organizations reveals that there is a relation between the intensity in which techniques are used by organizations and the classification of that organization (correlation 0.626, significant at 0.01 level; results not presented here)[23]. The survey data indicate that SRA-users hardly use PRA- or GOTA-techniques. PRA-users use SRA- and PRA-techniques, but do not use GOTA-techniques intensively; and GOTA-users use SRA-, PRA- and GOTA-techniques. The classification of organizations is thus not mutually exclusive, but refers to the most advanced techniques used within the organization. The data also suggest that the classification used in this thesis also provide an indication on how many uncertainties techniques are used in capital budgeting. Apparently, organizations apply *more* capital budgeting practices as uncertainty increases rather than *different* capital budgeting practices[24].

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22 The scores of multiple item scales are generally combined by adding them to form a single somposite score, which is then used in further analysis. This is standard practices in much of the research in social sciences (see Shevlin et al [1997].

23 The results from the Pearson correlation are similar to the results of the Spearman correlation and the Kendall correlation.

24 This observation is confirmed by the correlation between the classification in SRA-, PRA- and GOTA-users and SRA-techniques (.44; p<.01), PRA-techniques (.63; p<.01), GOTA-techniques (.48; p<.01) and total number of techniques used (.63; p<.01).

It should be noticed that the operationalization of "advanced" or "sophisticated" capital budgeting practices in this study (PRA-, GOTA-user) is different from the definitions used in some other research projects (see Ho & Pike [1992]; Haka et al [1985]; Schall & Sundem [1980]). Most research projects mentioned previously classified discounted cash flow techniques, sometimes supplemented with risk analysis techniques, as "sophisticated". In this thesis, the relevant criterion is whether organizations apply an structured approach to (most) investment decisions, i.e. whether they structurally identify and analyse uncertainty, adjust for uncertainty and base their investment decision on criteria that recognise (the costs of) uncertainty[25].

5.2.6 Trends in Capital Budgeting Practices

The previous sections of this chapter have provided insight in the capital budgeting practices of large organizations in the Netherlands. Based on the results, it is concluded that the current results are quite similar to the results from current surveys in other Western countries. In addition to that, two of the trends observed internationally (increasingly higher "application rates" of DCF-methods, combination of capital budgeting selection rules) are also discernable in the Netherlands. The other international trend (increase in the application of uncertainty analysis tools) is not verifiable due to the lack of observations in the Dutch past. Based on the results presented in this chapter, the first two hypotheses of this thesis (trends in and "application rates" of capital budgeting practices) are (at least partially) confirmed.

[25] The survey reveals that 76% of the respondents uses discounted cash flow techniques and 85% uses risk analysis techniques on a regular basis. This means that 65%-75% of the organizations would classify as "advanced" if these classification criteria would have been used.

5.3 Uncertainty and Capital Budgeting Practices

The relation between uncertainty and capital budgeting practices is investigated in more detail in this section. In the analysis, it is noteworthy that there is a difference between the uncertainty about that variable and the impact of an uncertainty variable on capital budgeting practices. The first issue, the interrelations between the uncertainties are investigated to see what uncertainties "team up" and to identify the "constituent parts of uncertainty". Next, the relations between the uncertainties recognized by Miller [1992] and capital budgeting practices are discussed. Finally, the relation between the "total uncertainty measure" and capital budgeting practices is investigated.

5.3.1 The Constituent Parts of Uncertainty

The next table (component matrix) provides some data on the "constituent parts of uncertainty".

Component matrix [a]		Component		
		1	2	3
General uncertainties	Political uncertainties	,369	,441	,486
	Policy uncertainties	,158	,461	,483
	Exchange rate uncertainties	,519	,122	-,472
	Interest uncertainties	,522	,512	-,367
	Inflation uncertainties	,604	,475	-,369
	Social uncertainties	,354	,300	,474
	Natural uncertainties	,471	,394	,225
Industry uncertainties	Input market uncertainties	,506	-,473	,146
	Output market uncertainties	,350	-,375	-,237
	Competitive uncertainties	,164	-6,842E-02	-,294
Organizational uncertainties	Labor uncertainties	,617	-,301	,104
	Input uncertainties	,511	-,569	,106
	Production uncertainties	,585	-,376	,182
	Liability uncertainties	,393	-,345	,253
	R&D uncertainties	,424	-8,208E-02	6,802E-02
	Credit uncertainties	,489	9,783E-02	-,374
	Behavioral uncertainties	,585	9,520E-02	2,895E-02

Extraction Method: Principal Component Analysis. a = 3 components extracted. Original Likert-scores.

Table 5.14: *Constituent Parts of Uncertainty*[26]

[26] The previous table presents the results for the original Likert-scores (1-5). *Appendix 5.1* presents the results for the dichotomous scores (0-1, groups of fairly equal size). The results for the dichotomous scores are similar to the results for the Likert-scores.

The previous table provides the results from a Principal Component Analysis on all the uncertainties in the framework. The data suggest that uncertainty be constructed out of three components. The first component is an "all-purpose uncertainty factor": all uncertainties load (positively) upon this component. The second component distinguishes between "supra-industry uncertainty factors" (positive loading) and "industry/organization uncertainty factors" (negative or [almost] zero loading). Finally, the third component distinguishes among those factors that mainly are related to more qualitative societal/policy uncertainty factors (positive/[almost] zero loading) and financial price/output uncertainty factors (negative loading). The "financial price/output uncertainty factor" addresses whether the organization is vulnerable to (global) changes in macro-economic factors affecting sales to (exchange rate, inflation, output market and competitive uncertainties) or payments by customers (credit uncertainties). The "qualitative societal/policy uncertainty factor" indicates whether the organization is vulnerable to changes in the (legal, social or physical) environment of the organization. These qualitative uncertainty factors are "hard to grasp" in financial analyses since there are hardly any data on them.

The previous section has provided insight in the "constituent parts of uncertainty". That is, the Principal Component Analysis of all uncertainties has revealed which specific uncertainties "team up". The results do not provide any information on the relation between uncertainty and capital budgeting practices; this information is presented in the following section(s).

5.3.2 General Uncertainties

The next table presents the test results for the impact of specific general uncertainties on the application of advanced capital budgeting practices. General uncertainties refer to uncertainties that affect the business context across industries within one country. The table shows the tabulation for the frequency of respondents classified in either one of three capital budgeting qualifications (SRA, PRA and GOTA) and in one of two "uncertainty groups", (high versus low) indicating the importance of the specific uncertainty to the organization. The fourth column presents the total number of observations. Finally, the last two columns present the statistics of the Kruskal-Wallis (KW) test. The KW-test statistics include the mean rank for each group observations, the test statistic H', the degrees of freedom (Df) and the asymptotic significance (P).

Capital Budgeting Practice / General Uncertainty	SRA-user	ARA-user		To-Tal	KW-test	
		PRA	GOTA		Mean Rank	Test statistics
Political uncertainties						
Not important – mostly unimportant (score 1-2)	50	31	5	86	89	$H' = 0.402$
Neutral – very important (score 3-5)	52	36	8	96	93	Df = 1
Total	102	67	13	182		P = 0.526
Policy uncertainties						
Not important – neutral (score 1-3)	41	22	5	68	88	$H' = 0.708$
Important – very important (score 4-5)	61	46	8	115	94	Df = 1
Total	102	68	13	183		P = 0.400
Exchange rate uncertainties						
Not important – neutral (score 1-3)	62	36	8	106	90	$H' = 0.662$
Important – very important (score 4-5)	40	33	5	78	96	Df = 1
Total	102	69	13	184		P = 0.416
Interest uncertainties						
Not important – neutral (score 1-3)	63	41	4	108	89	$H' = 1.765$
Important – very important (score 4-5)	39	28	9	76	98	Df = 1
Total	102	69	13	184		P = 0.184
Inflation uncertainties						
Not important – neutral (score 1-3)	70	39	5	114	86	$H' = 5.232$
Important – very important (score 4-5)	32	30	8	70	102	Df = 1
Total	102	69	13	184		P = 0.022
Social uncertainties						
Not important – mostly unimportant (score 1-2)	42	30	6	78	94	$H' = 0.160$
Neutral – very important (score 3-5)	60	39	7	106	91	Df = 1
Total	102	69	13	184		P = 0.689
Natural uncertainties						
Not important – mostly unimportant (score 1-2)	55	41	6	102	93	$H' = 0.068$
Neutral – very important (score 3-5)	47	28	7	82	91	Df = 1
Total	102	69	13	184		P = 0.794

Table 5.15: *Impact of general uncertainties on capital budgeting practices*

Neither political uncertainties, nor policy uncertainties have an impact on capital budgeting practices. At first sight, two out of the three macro-economic uncertainties (exchange rate uncertainty, interest uncertainty) do not seem to have an impact on capital budgeting practices. However, inflation uncertainties have an impact on the application of advanced capital budgeting practices[27]. Finally, social uncertain-

[27] According to the classical theory of interest, a change in the expected inflation will cause the same change in the nominal interest rate (see Fisher [1930]). An examination of the correlation between interest rate uncertainties and inflation uncertainty reveals that these uncertainties are related (correlation 0.712, P<0.01). It should be noticed that it is quite strange that interest rate uncertainties do not have an impact, while inflation uncertainties do have an impact on capital budgeting practices (especially considering their covariance). The interrelationships between these variables are discussed in more detail in section 5.4.

ties and natural uncertainties do not have an impact on the application of advanced capital budgeting practices, either. Apparently, these uncertainties are not managed by (an adaptation of) capital budgeting practices.

It is interesting to note that even though some uncertainties are considered fairly important by organizations (such as government policy uncertainties; see *Appendix 4.1*), they do not have an impact on capital budgeting practices. Apparently, organizations do not change their capital budgeting practices to deal with these uncertainties. Based on these results it is concluded that only inflation uncertainties have a significant impact on the application of sophisticated capital budgeting practices. Other general uncertainties (such as political uncertainties, policy uncertainties, social uncertainties and natural uncertainties) are not related to the application of advanced capital budgeting practices.

5.3.3 Industry Uncertainties

The next table shows the test results for the impact of specific industry uncertainties on the application of advanced capital budgeting practices. The structure of table 5.16 is similar to the structure of the previous one.

Capital Budgeting Practice / Industry Uncertainty	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean rank	Test statistics
Input market uncertainties						
Not important – neutral (score 1-3)	55	34	9	98	93	$H' = 0.000$
Important – very important (score 4-5)	47	36	4	87	93	Df = 1
Total	102	70	13	185		P = 0.989
Output market uncertainties						
Not important – neutral (score 1-3)	39	12	4	55	80	$H' = 6.360$
Important – very important (score 4-5)	63	58	9	130	99	Df = 1
Total	102	70	13	185		P = 0.012
Competitive uncertainties						
Not important – neutral (score 1-3)	32	18	2	52	86	$H' = 1.511$
Important – very important (score 4-5)	70	52	11	133	96	Df = 1
Total	102	70	13	185		P = 0.219

Table 5.16: *Impact of specific industry uncertainties on advanced capital budgeting practices*

Table 5.16 reveals that input market uncertainties do not have an impact on capital budgeting practices. One possibility is that organizations are generally in a position to (partially) charge changes in input market prices (labor, materials, machines) to their customers. Another possibility is that some uncertainties in the input market mix offset each other (for example, an increase in labor costs may be offset by a decrease in the costs of certain materials or machinery). Organizations do not seem to

deal with competitive uncertainties in the investment decision, either: there is no significant relation between competitive uncertainties and capital budgeting practices. Even though input market and competitive uncertainties are important to organizations (see *Appendix 4.1*), they do not have an impact on capital budgeting practices.

Output market uncertainties do have a significant impact on capital budgeting practices; the observed differences for output prices are statistically significant. Apparently, an increase in the uncertainties in the output market results in a change in capital budgeting practices.

5.3.4 Organizational Uncertainties

The next table shows the test results for the impact of specific organizational uncertainties on the application of advanced capital budgeting practices. The structure of table 5.17 is similar to that of other tables in this section.

Table 5.17 suggests that operational uncertainties, such as labor uncertainties, input uncertainties and production uncertainties, do not affect capital budgeting practices. Also, R&D uncertainties are not associated with specific capital budgeting practices. The frequency distribution of organizations does not change, as these uncertainties become more important. Liability uncertainties do have an impact on capital budgeting practices: apparently, organizations use advanced capital budgeting practices to determine whether investments in specific products or markets are worthwhile.

Capital Budgeting Practice / Organizational Uncertainty	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean Rank	Test statistics
Labor uncertainties						
Not important – mostly unimportant (score 1-2)	43	26	4	73	89	$H' = 0.815$
Neutral – very important (score 3-5)	59	44	9	112	96	Df = 1
Total	102	70	13	185		P = 0.367
Input uncertainties						
Not important – mostly unimportant (score 1-2)	47	35	6	88	94	$H' = 0.147$
Neutral – very important (score 3-5)	55	35	7	97	92	Df = 1
Total	102	70	13	185		P = 0.701
Production uncertainties						
Not important – neutral (score 1-3)	62	37	6	105	88	$H' = 1.873$
Important – very important (score 4-5)	39	33	7	79	98	Df = 1
Total	101	70	13	184		P = 0.171
Liability uncertainties						
Not important – neutral (score 1-3)	66	38	5	109	87	$H' = 3.824$
Important – very important (score 4-5)	36	32	8	76	101	Df = 1
Total	102	70	13	185		P = 0.051
R&D uncertainties						
Not important – mostly unimportant (score 1-2)	40	24	7	71	93	$H' = 0.001$
Neutral – very important (score 3-5)	62	46	6	114	93	Df = 1
Total	102	70	13	185		P = 0.974
Credit uncertainties						
Not important – neutral (score 1-3)	68	48	3	119	89	$H' = 2.213$
Important – very important (score 4-5)	33	22	10	65	99	Df = 1
Total	101	70	13	184		P = 0.137
Behavioral uncertainties						
Not important – mostly unimportant (score 1-2)	47	27	2	76	85	$H' = 3.333$
Neutral – very important (score 3-5)	55	43	11	109	98	Df = 1
Total	102	70	13	185		P = 0.068

Table 5.17: *Impact of organizational uncertainties on capital budgeting practices*

The test results on credit uncertainties are mixed. The frequency distribution slightly changes when credit uncertainties become more important; however, the impact of credit uncertainties on capital budgeting practices is not statistically significant[28]. The impact of credit uncertainties may be related to the credit terms of certain industries as well as to the credit habits of certain customers. A closer analysis of the responses indicates that credit uncertainties are relatively important to financial institutions (banks and insurance companies); financial institutions generally

[28] The Mann-Whitney U test provides similar results as the Kruskal-Wallis test; however, the χ^2-test indicates that credit uncertainties have a significant impact on the application of risk management techniques in the investment decision ($\chi^2 = 10.622$, df=2, P=0.005).

use more advanced capital budgeting techniques than other industries do. The research results seem to suggest that organizations start using more advanced capital budgeting practices when their cash inflows become less certain.

Finally, behavioral uncertainties (agency costs, fraud) also seem to have an impact on capital budgeting practices. The results for the impact of behavioral uncertainties on capital budgeting practices are statistically significant. One possible explanation is that managers in "agency organizations" have to explain in more detail to their superiors why they want to invest in certain projects. In organizations where the owner is also the manager, the owners generally make the investment decisions. Considering that the owners will generally be involved in operational business operations, they may judge investment proposals without additional analysis. In "agency organizations", managers may use advanced methods to prove that certain projects are valuable to the (owners of the) organization, no matter what happens. Another possibility is that behavioral uncertainties are related to the size of organizations; however, a closer analysis of the responses does not indicate that there is a relation between size and the impact of behavioral uncertainties. It is concluded that behavioral uncertainties have an impact on the application of advanced capital budgeting practices.

5.3.5 Additional Considerations

It is interesting to see that three uncertainties that have an impact on capital budgeting practices (inflation, output market and credit) load negatively on the "financial price/output uncertainty factor"; see section 5.3.1). One other uncertainty (behavior) has a loading of (almost) zero, and the other uncertainty (liability) loads positively on the third factor[29]. To investigate the relation between the financial price/output factor and the impact of uncertainty on capital budgeting practices more closely, it has been decided to use the additional data that are available through the measurement instrument. Up until now, it has been tried to determine whether different values for specific variables (uncertainty, other contingency variables) are associated with a change in capital budgeting practices. Generally, it has been tested whether the test variable (i.e., advancedness of capital budgeting practices) differs significantly among these groups. For the purposes of these tests, several variables that have been measured on a five-point scale (uncertainties, objectives) have been reclassified in two groups; therefore, this reclassification has resulted in the loss of measurement information.

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29 These loadings do not change significantly after they are dichotomized; see *Appendix 5.1.*

The previous sections have analysed whether capital budgeting practices change if the value of the grouping variable altered. It is also possible to test this relation "the other way around", i.e., does the value of the grouping variable change if capital budgeting practices change. By reversing this relation, it is possible to utilise more of the available information. For the purposes of this "reversing action", the SRA-, PRA- and GOTA-classifications have been defined as a grouping variable; the uncertainties have been defined as test variables. The "reversing action" originates from the explorative character of this research project; it is meant to identify as many factors as possible that affect capital budgeting practices. It may reveal additional information on the relation between the uncertainties that affect capital budgeting practices and the "financial price/ output factor". The findings from the "reversing action" may reduce the impact of the (combined) variables, but increase the insight in the determinants of capital budgeting practices. The test results are discussed only when they differ significantly from the results in the previous sections of this thesis.

There are three additional uncertainties that, based on this "reversing action", may also have an impact on capital budgeting practices[30]. These uncertainties are exchange rate uncertainties, interest uncertainty and credit uncertainty. Indeed, these factors are (mostly) associated with the financial price/output factor mentioned in section 5.3.1. The uncertainties will be discussed briefly.

Exchange rate uncertainties

The next table presents the results for exchange rate uncertainties. The table shows the average importance of exchange rate uncertainties (based on a 5-point Likert scale), the number of observations and the mean rank for either one of three capital budgeting qualifications (SRA, PRA and GOTA). The last 2 columns present the statistics of the Kruskal-Wallis test (mean rank for each group observations, the test statistic H', the degrees of freedom, Df, and the asymptotic significance, P).

30 The "reversing action" also indicates that two factors that are considered to have an impact on capital budgeting practices, may not be related to them: liability uncertainty (P=0.385) and behavioral uncertainty (P=0.185). These uncertainties are not discussed here; they are assumed to influence capital budgeting practices, based on previous results. It is noticeable, however, that the inclusion of these uncertainties may reduce the significance of the resulting multiple contingency framework.

		Exchange Rate Uncertainty		KW-test	
Capital Budgeting Practice		**Average Importance**	**Number of observations**	**Mean Rank**	**Test Statistics**
	SRA-user	2.87	102	86	H'= 4.186
ARA-	PRA-user	3.26	69	102	Df = 2
user	GOTA-user	3.23	13	99	P = 0.123
Average/Total		3.04	184		

Table 5.18: *Importance of exchange rate uncertainties among investment categories*

Table 5.18 indicates that exchange rate uncertainties are more important to both PRA-users and GOTA-users than to SRA-users. The impact of these uncertainties may be related to a number of issues. First, the value of foreign direct investments of organizations is affected by changes in exchange rates (Smidt [1999]). Also, the competitive position of organizations may be affected by changes in exchange rates (Smith et al [1990], p. 23). Finally, organizations that invest in foreign countries often have to deal with new and previously unknown uncertainties (legislation, trade barriers, etc.; see Daniels & Radebaugh [1989]). Organizations seem to deal (at least partially) with these issues in the investment decision. It is noticeable that the results are not overwhelmingly significant; however, when the organizations are split in two groups (SRA- and ARA-users; the last group combines PRA- and GOTA-users) the results from the Mann-Whitney test are significant (U=3472, Z= -2.038, P=0.042). Based on these results, it is concluded that an increase in exchange rate uncertainty is associated with the application of more sophisticated capital budgeting practices.

Interest rate uncertainty

The results for interest rate uncertainty are presented in the next table; the structure of this table is similar to the previous table in this section.

		Interest Rate Uncertainty		KW-test	
Capital Budgeting Practice		**Average Importance**	**Number of Observations**	**Mean Rank**	**Test Statistics**
	SRA-user	3.04	102	85	H'= 7.498
ARA-	PRA-user	3.32	69	97	Df = 2
User	GOTA-user	3.85	13	124	P = 0.024
Average/Total		3.20	184		

Table 5.19: *Importance of interest rate uncertainties among investment categories*

The test results indicate that interest uncertainties differ significantly among investment categories (SRA-, PRA- and GOTA-users). An increase in interest uncertainty is associated with the application of more advanced capital budgeting practices[31].

Credit uncertainties

The results for credit uncertainties are presented in the next table; the structure is similar to the previous tables in this section.

		Credit Uncertainties		KW-test	
Capital Budgeting Practice		**Average Importance**	**Number of Observations**	**Mean Rank**	**Test Statistics**
ARA-user	SRA-user	2.93	101	89	H'= 8.774
	PRA-user	2.96	70	90	Df = 2
	GOTA-user	3.85	13	133	P = 0.012
Average/Total		3.01	184		

Table 5.20: *Importance of credit uncertainties among investment categories*

The test results indicate that credit uncertainties differ significantly among the three investment categories: credit uncertainties are relatively unimportant to SRA- and PRA-users, while they are relatively important to GOTA-users (statistically significant; H'= 8.774, P=0.012). The differences between these results and the results from the Kruskal-Wallis test in section 5.3.2 stem from the fact that the division in two uncertainty groups has blended the impact of credit uncertainties.

5.3.6 Total Uncertainty

Finally, measures for "category uncertainty" and for "total uncertainty" can be derived. The "category uncertainty score" for each category is computed by summarizing the scores for the uncertainties in that category. The "total uncertainty score" is computed by summarizing the scores for all uncertainties experienced by the respondent[32]. The next table presents the results for the relation between uncertainty and capital budgeting practices; the structure of this table is similar to those of other tables in this section.

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31 This is consistent with the fact that inflation uncertainties influence capital budgeting practices.

32 Summarizing scores is standard practice in much of the research in social sciences (see Shevlin et al [1997]).

Capital Budgeting Practice / Uncertainty	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean rank	Test statistics
General Uncertainty						
Low	43	21	3	67	84	$H' = 3.749$
Moderate	37	35	5	77	99	Df = 2
High	22	14	5	41	96	P = 0.153
Total	102	70	13	185		
Industry Uncertainty						
Low	45	18	5	68	84	$H' = 4.240$
Moderate	35	33	4	72	98	Df = 2
High	22	19	4	45	99	P = 0.120
Total	102	70	13	185		
Organizational Uncertainty						
Low	34	23	3	60	91	$H' = 2.535$
Moderate	41	25	3	69	88	Df = 2
High	27	22	7	56	101	P = 0.282
Total	102	70	13	185		
Total Uncertainty						
Low	39	20	1	60	82	$H' = 4.635$
Moderate	33	25	6	64	97	Df = 2
High	30	25	6	61	99	P = 0.099
Total	102	70	13	185		

Table 5.21: *Impact of uncertainties on capital budgeting practices*

The results from table 5.21 suggest that an increase in the category uncertainties (general, industry and organizational uncertainties) has no statistically significant impact on capital budgeting practices. However, an increase in total uncertainty seems to affect capital budgeting practices: the observed differences are significant at the 10%-level[33].

5.3.7 Conclusion on Uncertainty and Capital Budgeting Practices

From the observations in this section, it is concluded that specific uncertainties (exchange rate, interest, inflation, output market, liability, credit and behavior) have an impact on (the sophistication of) capital budgeting practices of organizations. A number of uncertainties apparently does not have an impact on the capital budgeting decision, even though they are important to the results of the organization (see also *Appendix 4.1*). Most of the uncertainties that affect capital budgeting practices load negatively on the "financial price/output uncertainty factor" (with the exception of liability uncertainty and behavioral uncertainty; see section 5.3.1). More

[33] The results for the t-tests are similar to the results from the KW-test presented previously.

qualitative uncertainty factors, such as policy uncertainty or social uncertainty, do not seem to have an impact on capital budgeting practices.

In addition, it is concluded that "total uncertainty" also has an impact on capital budgeting practices (at the 10%-level). Therefore, the hypotheses (3 and 4) that state that an increase in both total uncertainty as well as in specific uncertainties is associated with advanced capital budgeting practices are confirmed. This result is different from the results obtained by Schall & Sundem [1980], who found that uncertainty was not related to capital budgeting practices. The results from this study are (mostly) in concordance with the results by Chen [1995], Haka [1987], Kim [1982] and Klammer [1973]. The difference in the results between this study and the study by Schall & Sundem [1980] may arise from the different definitions of "sophisticated" capital budgeting practices. Apparently, uncertainty does not have an impact on the capital budgeting decision rule alone, but affects the whole capital budgeting process (which has already been argued by Kim [1982]).

It should be noticed that, even though it is significant at the 10%-level, "total uncertainty" alone is not likely to provide insight in the details of the relation between uncertainty and capital budgeting practices. That is, the significance of the relation between specific uncertainties (inflation, output market, liability, etc.) and the application of sophisticated capital budgeting is higher than the significance of the general measure of uncertainty (such as, for example, "total uncertainty"). Therefore, a combination of specific uncertainties may be a more useful measure for the purposed of this research project; section 5.5 elaborates further on this notion.

5.4 Other Contingency Factors and Capital Budgeting Practices

In addition to uncertainty, a number of other contingency factors have been identified that are expected to affect capital budgeting practices. Some of these contingency factors (such as environment, technology, strategy, size and industry) are discussed in this section.

5.4.1 Environment

The next table presents the test results for the impact of the environment on the application of advanced capital budgeting practices. The table shows the tabulation for the frequency of respondents classified in either one of three capital budgeting qualifications (SRA, PRA and GOTA) and in one of four "environmental groups".

The rows present the number of organizations in that environmental category, distributed among the three investment classifications; the fourth column presents the total number of observations found in each environmental category. Finally, the last two columns present the statistics of the Kruskal-Wallis test: the mean rank for each group observations, the test statistic H', the degrees of freedom (Df) and the asymptotic significance (P).

Capital Budgeting Practice / Environment	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean rank	Test statistics
Simple and stable	11	2		13	65	H' = 5.25
Simple and dynamic	24	17	2	43	91	Df = 3
Complex and stable	9	9		18	95	P = 0.154
Complex and dynamic	58	41	11	110	96	
Total	102	69	13	184		

Table 5.22: *Impact of environment on capital budgeting practices*

The results from table 5.22 do not reveal much information with regard to capital budgeting practices. Most organizations (60% of all respondents) consider their environment complex and dynamic. Organizations that characterize their environment as "simple and stable" use relatively simple capital budgeting techniques, (which is in concordance with expectations). Also, all GOTA-users operate in a dynamic environment: 2 GOTA-users operate in a "simple and dynamic" and 11 GOTA-users operate in a "complex and dynamic" environment. Therefore, a dynamic environment may be associated with the GOTA-techniques (which is also in

concordance with expectations). The observed differences are statistically not significant; therefore, it is concluded that the environment does not have an impact on capital budgeting practices (although this may be due to the fact that most organizations consider their environment as complex and dynamic).

5.4.2 Technology

Table 5.23 presents the test results for the impact of technology on the application of advanced capital budgeting practices. The structure of this table is similar to the structure of other tables in this section.

Capital Budgeting Practice / **Technology**	**SRA-user**	**ARA-user**		**Total**	**KW-test**	
		PRA	**GOTA**		**Mean rank**	**Test statistics**
Stable/long-lived	49	32	6	87	90	H' = 6.148
Fertile	25	11	1	37	79	Df = 2
Turbulent	25	27	6	58	102	P = 0.046
Total	99	70	13	182		

Table 5.23: *Impact of technology on capital budgeting practices*

The results from the test indicate that technology has an impact on capital budgeting practices; the observed differences are statistically significant at the 5%-level. Organizations seem to move towards more advanced capital budgeting techniques as technology becomes more unpredictable (which is in concordance with hypothesis 7). Considering the explorative nature of this research project, it has been decided to analyse this finding in more detail to learn more about the specifics of the relationship between technology and capital budgeting practices. When the survey data on technology are rearranged in two groups (stable/long-lived technology versus volatile technology, where the last group includes fertile and turbulent technology), there is no significant difference in capital budgeting practices between organizations in industries with stable/long-lived and volatile technologies (P>0.6). When the technology groups are rearranged in two other groups (stable/long-lived and fertile technology versus turbulent technology), the test results indicate that there are differences (H'=4.636, P=0.031)[34]. These observations are plotted in Figure 5.24.

[34] It is noticeable that the increase in significance (from 4.6% to 3.1%) is almost negligible. The analysis has been prompted by the explorative nature of the research project: as many variables as possible are identified and investigated to provide a "sharp" descriptive model. In addition, the analysis is necessary for additional research (see section 5.4 and section 6.2).

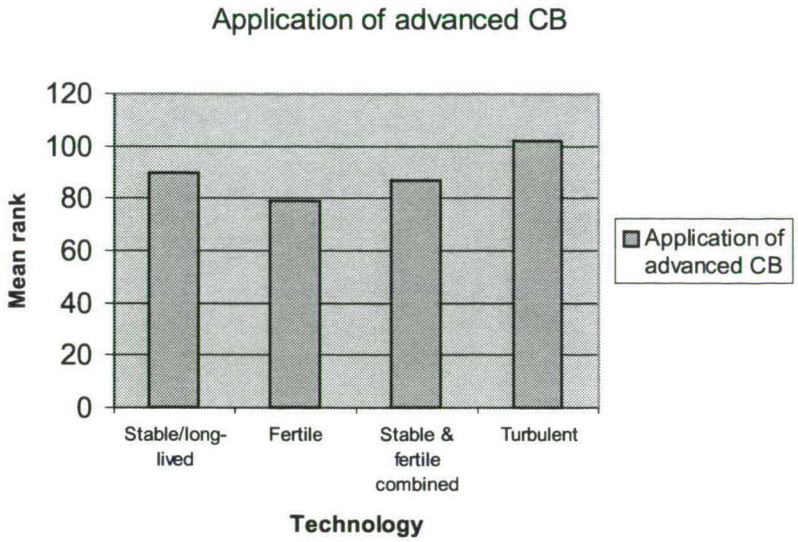

***Figure 5.24**: Technology and capital budgeting practices*

One possible explanation for the recognized differences is that organizations first move to more intuitive adjustments for uncertainty in the investment decision when technologies become fertile. When technologies become turbulent, organizations start using advanced capital budgeting selection techniques (such as option pricing and game theory decision rules) to deal with them.

Another possibility is that technological change is more or less equivalent to some of the uncertainties discussed previously. To check whether this assumption is correct, the relation between technology and some uncertainties (industry uncertainty as well as total uncertainty) has been investigated. The results provide no evidence that uncertainty increases as technologies change.

Based on previous analysis, it is concluded that organizations with turbulent technologies use more advanced capital budgeting practices than organizations with relatively orderly technologies (both stable/long-lived technologies and fertile technologies). Therefore, hypothesis 7 (an increase in turbulence is associated with advanced capital budgeting practices) is confirmed. The (turbulence of) technology has not been identified as a (separate) determinant of capital budgeting practices; additional research is necessary to establish the "definite" relation between these variables.

5.4.3 Strategy

Four elements from the strategy framework (organizational objectives, corporate strategy, business unit strategy and investment strategy) are discussed.

Organizational Objectives
Table 5.25 presents the test results for the impact of the objectives on capital budgeting practices. The structure of the table is similar to that of previous tables in this section.

Capital Budgeting Practice / Objective	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean rank	Test statistics
Profit, profit margin						
Not important – important (score 1-4)	41	33	3	77	91	$H' = 0.023$
Very important (score 5)	59	34	10	103	90	Df = 1
Total	100	67	13	180		P = 0.880
Operational cash flows						
Not important – neutral (score 1-3)	29	20	6	55	94	$H' = 0.624$
Important - very important (score 4-5)	71	46	7	124	88	Df = 1
Total	100	66	13	179		P = 0.429
Shareholder value, stock price, dividends						
Not important – neutral (score 1-3)	52	31	3	86	82	$H' = 2.671$
Important - very important (score 4-5)	45	34	10	89	93	Df = 1
Total	97	65	13	175		P = 0.102
Cost reduction						
Not important – important (score 1-4)	70	46	8	124	90	$H' = 0.066$
Very important (score 5)	31	20	5	56	92	Df = 1
Total	101	66	13	180		P = 0.798
Sales growth						
Not important – neutral (score 1-3)	30	19	5	54	91	$H' = 0.024$
Important - very important (score 4-5)	70	48	8	126	90	Df = 1
Total	100	67	13	180		P = 0.876
Market share						
Not important – neutral (score 1-3)	35	26	5	66	93	$H' = 0.250$
Important - very important (score 4-5)	65	41	8	114	89	Df = 1
Total	100	67	13	180		P = 0.617
Development of new markets and products						
Not important – neutral (score 1-3)	33	24	5	62	92	$H' = 0.191$
Important - very important (score 4-5)	66	43	8	117	89	Df = 1
Total	99	67	13	179		P = 0.662
Research & Development						
Not important – neutral (score 1-3)	57	40	8	105	92	$H' = 0.178$
Important - very important (score 4-5)	43	27	5	75	89	Df = 1
Total	100	67	13	180		P = 0.673
Quality of products, service to customers						
Not important – important (score 1-4)	61	37	7	105	89	$H' = 0.535$
Very important (score 5)	40	30	6	76	94	Df = 1
Total	101	67	13	181		P = 0.465
Personnel development, human resources						
Not important – neutral (score 1-3)	39	23	6	68	90	$H' = 0.021$
Important - very important (score 4-5)	62	44	7	113	91	Df = 1
Total	101	67	13	181		P = 0.884
Political and public effects						
Not important – neutral (score 1-3)	57	40	8	105	90	$H' = 0.088$
Important - very important (score 4-5)	43	27	5	75	92	Df = 1
Total	100	67	13	180		P = 0.767
Ethical performance						
Not important – neutral (score 1-3)	49	33	5	87	89	$H' = 0.078$
Important - very important (score 4-5)	51	33	8	92	91	Df = 1
Total	100	66	13	179		P = 0.781

Table 5.25: *Impact of specific objectives on capital budgeting practices*

An examination of table 5.25 suggests that the objectives of an organization do not have a significant impact on capital budgeting practices. However, it is important to notice that profit/profit margin, cost reduction and quality of products/service to customers are considered important to very important by a large majority of the respondents. To divide the respondents in two groups of considerable size, a distinction had to be made between organizations that consider these objectives very important (score: 5) and organizations that consider this objective not important too important (score 1-4)[35]. Since most respondents seem to have similar objectives, it may be difficult to draw conclusions from the available data with regard to the impact of the objectives on capital budgeting practices.

The hypothesis that the increased importance of operating profits/profit margins and cost reduction is associated with the application of relatively simple capital budgeting practices, is not confirmed by the observations. The hypothesis that the objective (generation of) operational cash flows is associated with the application of sophisticated capital budgeting practices, is not confirmed by the observations, either. The goal shareholder value/stock price/dividends seem to covary with the application of sophisticated capital budgeting practices. Considering the relatively low significance, the sub-hypotheses of hypothesis 8 (the objectives of an organization have an impact on capital budgeting practices) are denied.

It is concluded that the objectives of organizations do not seem to have an impact on capital budgeting practices. This observation may be due to the fact that the profit objective is important or very important to 93% of the organizations (whether they are SRA-, PRA- or GOTA-user); apparently, other objectives are subdued to this objective. It appears as if other objectives than profit are "added" to the capital budgeting process: in addition to providing profit, the investment project should also increase shareholder value, quality or market share. Hypothesis 8, which stated that there is a relation between the objectives of an organization and its capital budgeting practices, is therefore denied.

35 The average importance of the objectives also indicates that the objectives mentioned previously (profit, cost reduction and quality) are most important to the majority of respondents. The average importance of the profit objective is 4.48, the average importance of the cost reduction objective is 4.15 and the average importance of the quality of products and service to customers is 4.26. Also, most respondents indicate that these objectives are important to very important to their organization (93% [168/180] for the profit objective, 85% [153/180] for the cost reduction objective and 87% [158/181] for the quality of products/service to customers objective).

Corporate strategies

Table 5.26 shows the tabulation for the frequency distribution of respondents, classified in either one of three capital budgeting qualifications (SRA-, PRA- and GOTA-user) and in one of three alternative corporate strategies (single business, related diversified, unrelated diversified). The structure of this table is similar to previous ones.

Capital Budgeting Practice / Corporate Strategy	SRA-user	ARA-user: PRA	ARA-user: GOTA	Total	KW-test: Mean rank	KW-test: Test statistics
Single business	53	28	6	87	87	$H' = 2.519$
Related diversified	30	23	4	57	94	Df = 2
Unrelated diversified	18	19	3	40	101	P = 0.284
Total	101	70	13	185		

Table 5.26: *Impact of corporate strategy on capital budgeting practices*

It appears as if a single business unit strategy is related with the application of relatively simple capital budgeting practices, while an unrelated diversified strategy is associated with the application of more advanced capital budgeting practices. However, the Kruskal-Wallis test results indicate that there does not seem to be a relation between corporate strategy and capital budgeting practices: the observed differences are statistically not significant. Therefore, hypothesis 9 (which stated that there is no relation between corporate strategy and capital budgeting practices) is confirmed. Additional research on elements from corporate strategy, such as the impact of specific elements (Slagmulder[1997]), familiarity of top management with businesses (Lillis [1992]) or the formalization of planning and control procedures (Simons [1987]) is necessary to entangle the relation between (corporate) strategy and capital budgeting practices.

Business unit strategies

The next table reveals the results for the impact of business unit strategy on the application of sophisticated capital budgeting practices (see table 5.27).

Capital Budgeting Practice / Business Unit Strategy	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean rank	Test statistics
Build strategy	51	35	5	91	87	$H' = 0.149$
Hold strategy	40	28	6	74	89	Df = 2
Harvest strategy	6	2	2	10	89	P = 0.928
Total	97	65	13	175		

Table 5.27: *Impact of business unit strategy on capital budgeting practices*

The Kruskal-Wallis test results do not hint towards a relationship between business unit strategies and capital budgeting practices. Apparently, the generic strategies employed in this study do not provide a point of departure for research on the relation between strategy and capital budgeting. The business unit strategy by itself does not seem to have an impact on the application of advanced capital budgeting practices. Based on these results, hypothesis 10 (which did not expect a relation between business unit strategy and capital budgeting practices) is confirmed.

Investment strategy

Table 5.28 presents the tabulation of the frequency distributions for respondents classified in either one of three capital budgeting practices and in one of four investments strategies in investment decisions. The structure of the table is similar to others in this section.

Capital Budgeting Practice / Investment Strategy	SRA-user	ARA-user		Total	KW-test	
		PRA	GOTA		Mean rank	Test statistics
Insurance approach	12	17	4	33	103	$H' = 10.381$
Dedicated approach	26	16	4	46	85	Df = 3
Incremental approach	34	13	1	48	71	P = 0.016
Opportunistic approach	22	19	2	43	88	
Total	94	65	11	170		

Table 5.28: *Impact of investment strategy on capital budgeting practices*

The test results suggest that the investment strategy has an impact on capital budgeting practices; this finding confirms hypothesis 11. Apparently, the adoption of an "insurance" strategy (early investments in a broad category of projects) is associated with the application of sophisticated capital budgeting practices, (which is in concordance with sub-hypothesis 11a). On the other hand, the incremental approach delays investments until it is absolutely necessary to support the strategy or until key uncertainties are resolved favorably. The pre-specified performance measures and

the historic information that is available apparently result in the application of relatively simple capital budgeting practices (which is inconsistent with hypothesis 11c). The other two approaches (dedicated and opportunistic) do not seem to have an impact on capital budgeting practices (which is also inconsistent with hypothesis 11b). The results seem to suggest that advanced capital budgeting practices are associated with timing (early investments), not with the scope (breadth) of investment decisions. The investment strategy of an organization is not identified in previous research as a determinant of capital budgeting practices. Additional research may reveal the importance of this finding.

5.4.4 Size

Table 5.29 presents the test results for the impact of the size of an organization on the application of sophisticated capital budgeting practices. The structure of this table is similar to others in this section.

Capital Budgeting Practice		**ARA-user**			**KW-test**	
Asset Size	**SRA-user**	**PRA**	**GOTA**	**Total**	**Mean rank**	**Test statistics**
Asset size <ƒ 100 million	26	10	2	38	77	H' = 10.09
ƒ 100 million < asset size < ƒ 500 million	44	24	3	71	82	Df = 3
ƒ 500 million < asset size < ƒ 1 billion	11	9	3	23	97	P = 0.018
Asset size > ƒ 1 billion	16	23	4	43	104	
Total	97	66	12	175		

Table 5.29: *Impact of size on capital budgeting practices*

The results from table 5.29 indicate that an increase in size is associated with the application of advanced capital budgeting practices[36]. These results are in concordance with results from previous research (Pike [1996]; Klammer et al [1991]; Kim [1982]; Schall & Sundem [1980]) and confirm hypothesis 12. Apparently, there are economies of scale associated with the application of advanced capital budgeting practices.

[36] The tests have been repeated for other measures of size, including the number of employees (in full time equivalents) and sales. The results for these size measures are similar to the results for asset size.

5.4.5 Industry

The results on the application of capital budgeting practices among industries are presented in *Appendix 5.2*. The results indicate that there is no apparent relation between capital budgeting practices and industry. This observation is in accordance with recent empirical evidence from a study by Segelod [1998]. Segelod [1998] found that the capital budgeting techniques hardly differ among industries; however, the place and the frequency where capital budgeting techniques are applied are different. Manufacturing firms often have decentralised capital budgeting practices, while service groups hardly do such evaluations (since they have few large fixed investments). In addition, investment project evaluation is often done by a staff unit in service organizations (while capital budgeting projects are generally evaluated by line units in manufacturing firms). The available data and the statistical methods in this study do not provide a clear indication on the relation between industry and capital budgeting practices. Hypothesis 13, which stated that industry has an impact on capital budgeting practices, is therefore not fully confirmed by these results.

5.4.6 Conclusions on Other Contingency Factors and Capital Budgeting Practices

In addition to uncertainty, there appear to be a number of factors that have an impact upon capital budgeting practices. First of all, an increase in the turbulence of technology is associated with the application of more advanced capital budgeting practices. Firms in fertile technologies use rather simple capital budgeting practices, while firms in a turbulent field of technology use sophisticated capital budgeting practices. Second, the investment strategy is associated with changes in capital budgeting practices. An insurance approach is related with the application of advanced capital budgeting practices, while an incremental approach is associated with rather simple investment practices. Also, an increase in size is associated with the application of more sophisticated capital budgeting practices. Investment strategy and, to a lesser extent, (turbulence of) technology have not been recognised as determinants of capital budgeting practices in other research projects.

It has not been possible to discern whether two factors hypothesized to impact investment practices, environment and industry, are associated with specific capital budgeting practices. The available data and the classification/statistical methods do not provide a clear indication on the relations between these factors and investment practices.

Finally, there is a number of factors (for example, goals and objectives of organizations, corporate strategy, business unit strategy) that do not have an impact on capital budgeting practices. Either the measurement method used is not appropriate for the evaluation of the relations between these factors, or there is no such relation. Additional research on elements that constitute these factors (familiarity, formalization) may provide valuable insights in these relations.

5.5 The Multiple Contingency Profile for Capital Budgeting Decision Making

The previous sections of this chapter have identified a number of factors that have an impact on the capital budgeting practices. The following factors have been identified and will be analyzed in more detail, both separately as well as jointly:

- exchange rate uncertainties (uncertainty factor);
- interest uncertainties (uncertainty factor);
- inflation uncertainties (uncertainty factor);
- output market uncertainties (uncertainty factor);
- liability uncertainties (uncertainty factor);
- credit uncertainties (uncertainty factor);
- behavioral uncertainties (uncertainty factor);
- total uncertainty (uncertainty factor, sum of all uncertainties; see section 5.3);
- technology (contingency factor);
- investment strategy (contingency factor);
- size (contingency factor).

5.5.1 Relevant Uncertainty Score

In section 5.3.1, the constituent parts of uncertainty have been investigated. Additional analyses in the following sections have revealed that the specific uncertainties that impact capital budgeting practices mostly load negatively on the "financial price/output uncertainty factor" identified in section 5.3.1. Exchange rate, interest, inflation, output market, and credit uncertainty all load negatively on this factor; behavior is almost zero, and liability uncertainty loads positively on the financial price/output uncertainty factor. On the other hand, competitive uncertainty is also negatively related to the financial price/output factor but does not affect capital budgeting practices (see section 5.3). Therefore, a choice has to be made on a measure for uncertainty: the financial price/output uncertainty factor, total uncertainty or some other measure(s). Considering that the focus of this research project

is on the (specific) uncertainties that have an impact on capital budgeting practices, it has been decided to construct two measures that provide a measure for the degree of uncertainty relevant to capital budgeting practices (instead of using, for example, the financial price/output factor mentioned previously).

The relevant uncertainty score is derived from the available data to obtain a measure for the uncertainties that have an impact on capital budgeting practices. The Relevant Uncertainty Score (RUS) is calculated by summarizing the scores for the uncertainties considered relevant to capital budgeting practices (e.g. exchange rate uncertainties, interest uncertainties, etc.). The "Binary Relevant Uncertainty Score" (BRUS) is derived by the following procedure[37]:

1. The uncertainties considered relevant to capital budgeting practices (e.g. exchange rate uncertainties, interest uncertainties, etc.) are identified;
2. If the relevant uncertainty has a score above the limit where it has an impact upon capital budgeting practices (usually, this is the case when the uncertainty is either important or very important to the organization), it is coded by a "1"; otherwise, the uncertainty is coded by "0";
3. The binary scores for all relevant uncertainties are summarized to obtain the Binary Relevant Uncertainty Score (BRUS).

The BRUS is used within the remainder of this analysis since it results in a "sharper profile" than RUS[38], total uncertainty or the financial price/output uncertainty factor from section 5.3.1. The next table presents the test results for the relationship between the BRUS and capital budgeting practices.

Capital Budgeting Practice / **Binary Relevant Uncertainty Score**	**SRA-user**	**ARA-user**		**Total**	**KW-test**	
		PRA	**GOTA**		**Mean rank**	**Test statistics**
Low (score 0-2)	45	21	2	68	81	$H' = 10.201$
Moderate (score 3-4)	36	28	2	66	91	Df = 2
High (score 5-7)	20	20	9	49	109	$P < 0.01$
Total	101	69	13	183		

Table 5.30: *Impact of relevant uncertainties on capital budgeting practices*

37 Total uncertainty is not included in the relevant uncertainty score to prevent a "double count".

38 In RUS, the score of two 3's is equivalent to a score of 1 and 5. For BRUS, these scores would result in a BRUS of respectively 0 and 1.

Table 5.30 reveals that an increase in BRUS is associated with the application of sophisticated capital budgeting practices[39]. It should be noticed that the results for (B)RUS are far more significant than the results for total uncertainty (see section 5.3). This is only logical, since RUS and BRUS are measures based on those factors that affect capital budgeting practices. However, the notion that specific (combined) uncertainties have an impact on (the sophistication of) capital budgeting practices is important for further research and and may be regarded as one of the most important conclusions from this research project. The current research project provides organizations with the (ex ante) *determinants* (i.e., specific uncertainty factors) of capital budgeting practices rather than with an (ex post) measure resulting from previous investment projects.

5.5.2 Comparison of BRUS with β

It is interesting to see whether the specific uncertainties recognised in previous sections of this chapter are (all) incorporated in β, a measure of uncertainty that has been used in several other research projects (for example, Ho & Pike [1992]; Ho [1992]; Haka et al [1985]; Schall & Sundem [1980]).

It is not always possible to compare the BRUS derived previously with the β of organizations: not all organizations that participate in this research project are publicly traded organizations, and not all organizations have provided their name. In 23 cases it has been possible to obtain the β of an organization and to compare it with the BRUS as well as with the (dichotomized) specific uncertainties of an organization. Table 5.31 presents the results of this analysis[40].

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39 A t-test on capital budgeting practices (SRA, PRA and GOTA) and RUS (original scores) provides similar results ($F=8.05$, $p<.01$). Also, if the organizations are divided in three groups based on their RUS (RUS<21; 21<RUS<25; RUS>24) and combined with the capital budgeting practices (SRA, PRA and GOTA), the results are similar ($H'= 10.18$, $df=2$, $P<.01$).

40 The results are based on Pearson correlation; the results from the Pearson correlation are similar to the results of the Spearman correlation and the Kendall correlation. The results for the origical Likert-scores are similar to the results for the dichotomized scores (see *Appendix 5.3*).

Pearson Correl.	β	Exch uncrtty	Interest uncrtty	Infl Uncrtty	Output uncrtty	Liab uncrtty	Credit uncrtty	Behav uncrtty
β	1.000							
BRUS	0.439*							
Exch uncrtty	0.111	1.000						
Interest uncrtty	0.297	0.270**	1.000					
Infl uncrtty	0.239	0.299**	0.592**	1.000				
Output uncrtty	0.424*	0.050	0.006	0.113	1.000			
Liab uncrtty	0.446*	0.081	-0.003	0.042	0.092	1.000		
Credit uncrtty	0.098	0.165*	0.236**	0.234**	0.208**	0.133	1.000	
Behav uncrtty	0.028	0.001	0.192**	0.170*	0.121	0.170*	0.319**	1.000

*= correlation is significant at the 5%level; **= correlation is significant at the 1-% level.

Pearson correl. = Pearson correlation; β= β of organizations;
BRUS = binary relevant uncertainty score (sum of binary uncertainties);
Exch uncrtty = exchange rate uncertainty; Interest uncrtty = interest uncertainty;
Infl uncrtty = inflation uncertainty; Output uncrtty = output uncertainty;
Liab uncrtty = liability uncertainty; Credit uncrtty = credit uncertainty; Behav uncrtty = behavioral uncertainty.

Table 5.31: *Comparison of β with uncertainty factors*

Table 5.31 indicates that there seem to be both similarities as well as differences between β as a measure of uncertainty and the BRUS of an organization. First of all, the correlation between the BRUS and β is significant at the 5% level; this indicates that β as well as BRUS is an indicator for the uncertainty that organizations face. Additional tests (not presented here) indicate that β does have an impact on capital budgeting practices[41]. However, β is only available for publicly traded corporations; the BRUS derived here may also be valid for privately held corporations and for (business activities of) public sector and non-profit organizations.

[41] The test statistics from the Kruskal-Wallis test indicate that β does have an impact on capital budgeting practices (H'=4.086, df = 1, P = 0.043).

Another interesting observation is that β correlates with output uncertainty and liability uncertainty at the 5%-level. The data suggest that β only captures these uncertainty elements; other elements (such as exchange rate uncertainty, interest rate uncertainty, credit uncertainty or behavioral uncertainty) do not seem to be represented by β. It is possible that β only reflects some uncertainties relevant to the capital budgeting practices of an organization, not all of them. A potential explanation is that some of these uncertainties are already incorporated in the financial market. Also, a more extended correlation analysis (which is not included here) between β and other uncertainties (for example, political uncertainty or competitive uncertainty) reveals that β does not correlate with any other uncertainty.

5.5.3 A Comparison between Technology and Industry Code

It is expected that industry code may be an indicator for technological uncertainty. It is hypothesised that organizations within one industry face similar technological uncertainties; if that is the case, technology and industry codes are expected to be related. The next table presents the cross-tabulation on technology and industry.

Industry Code	Industry		Technology			Total
			Stable/ long-lived	Fertile	Turbulent	
A	Agriculture and forestry	Actual count	-	1	-	1
		Expected count	0.5	0.2	0.3	1
C	Mining & processing	Actual count	1	1	-	2
		Expected count	1.0	0.4	0.6	2
D	Manufacturing	Actual count	35	23	20	78
		Expected count	37.3	16.5	24.2	78
E	Public utilities	Actual count	9	3	2	14
		Expected count	6.7	3.0	4.3	14
F	Construction & building	Actual count	4	2	2	8
		Expected count	3.8	1.7	2.5	8
G	Wholesale & resale trade	Actual count	9	3	6	18
		Expected count	8.6	3.8	5.6	18
I	Transport & communication	Actual count	10	1	1	12
		Expected count	5.7	2.5	3.7	12
J	Finance & Insurance	Actual count	11	2	11	25
		Expected count	12.0	5.3	7.7	25
K	Leasing & professional	Actual count	5	-	10	15
	services	Expected count	7.2	3.2	4.6	15
L	Government, non-profit and	Actual count	4	2	5	11
	other services	Expected count	5.3	2.3	3.4	11
	Total		88	39	57	184

Table 5.32: *Classification of organizations by industry and technology*

Table 5.32 reveals that technology seems to be related to industry. The observed frequency distribution of organizations among technology classes is not always similar to the expected frequency distribution. For example, the observed frequency distribution in the industries transport & communication, finance & insurance and leasing & professional services are quite different from the expected frequency distribution[42]. These differences become more relevant as the industry code is refined (that is, if the industry code is extended to the first two digits of the SIC-codes). From these results, it is concluded that technology is related to industry and that industry code may be used as a proxy for technological change.

5.5.4 Association between Determinants

It is also important to investigate the interrelations among the relevant uncertainties, as well as the relations between the relevant uncertainties and other determinants (technology, size, investment strategy) of capital budgeting practices. This is necessary to prevent including similar measures within one "multiple contingency profile" (i.e., a profile that includes uncertainties and other determinants of capital budgeting practices). To determine the degree of association between the relevant uncertainties, other contingency factors and capital budgeting practices, a correlation analysis was executed. The next table presents the results for this correlation analysis.

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42 The χ^2 test provides a more definite answer to this observation. The data have to be regrouped to apply the χ^2 test since the χ^2 test requires that the expected frequencies in each cell should not be too small. The industries are regrouped in two classes: primary and secondary industry (industry code A up to and including industry code F); and tertiary industry and public sector (industry code G up to and including industry code L). For the purposes of this test, the three technology classes identified previously have been used (stable/long-lived, fertile and turbulent technology). The results from the χ^2-test indicate that technology and industry are related (χ^2=10.227, df=2, P=0.006).

Table 5.33: Correlation analysis between capital budgeting practices and uncertainty factors

Pearson Correl.	CB practice	BRUS	Exch uncrtty	Interest uncrtty	Infl uncrtty	Output uncrtty	Liab uncrtty	Credit uncrtty	Behav uncrtty	Invest strat	Size	Techn
CB practice	1.000											
BRUS	0.169*	1.000										
Exch uncrtty	0.048	0.268**	1.000									
Interest uncrtty	0.119	0.292**	0.270**	1.000								
Infl uncrtty	0.176*	0.304**	0.299**	0.592**	1.000							
Output uncrtty	0.162*	0.220**	0.050	0.006	0.113	1.000						
Liab uncrtty	0.151*	0.214**	0.081	-0.003	0.042	0.092	1.000					
Credit uncrtty	0.147*	0.206**	0.165*	0.236**	0.234**	0.208**	0.133	1.000				
Behav uncrtty	0.148*	0.357**	0.001	0.192**	0.170*	0.121	0.170*	0.319**	1.000			
Invest strat	0.196*	-0.21	-0.109	0.17	-0.003	0.037	0.059	0.065	0.006	1.000		
Size	0.229**	0.093	0.066	0.202**	0.058	-0.185*	-0.132	-0.065	0.010	0.067	1.000	
Techn.	0.158*	0.099	-0.002	0.004	0.058	0.055	0.235**	-0.032	0.078	0.046	0.002	1.000

*= correlation is significant at the 5%level; **= correlation is significant at the 1-% level.

Pearson correl. = Pearson correlation; CB practice = capital budgeting practice (SRA=1, PRA=2, GOTA=3); BRUS = relevant uncertainty score (sum of binary uncertainties); Exch uncrtty = exchange rate uncertainty; Interest uncrtty = interest uncertainty; Infl uncrtty = inflation uncertainty; Output uncrtty = output uncertainty; Liab uncrtty = liability uncertainty; Credit uncrtty = credit uncertainty; Behav uncrtty = behavioral uncertainty; Invest strat = investment strategy (insurance=1, others=0); Size = size (size over *f* 500 mln=1, others=0); techn = technology (innovative=1, others=0).

Table 5.33 presents the correlation[43] between the capital budgeting categories (with SRA=1, PRA=2 and GOTA=3) and the relevant uncertainties[44]. With the exception of the capital budgeting categories (that have retained their values for the three investment categories), all factors have been recorded in binary variables. Table 5.33 reveals that an increase in most uncertainties (with the exception of exchange rate uncertainty and interest uncertainty) is associated with the application of sophisticated capital budgeting practices. The correlation results therefore confirm the results from other statistical tests presented in previous sections. For example, the BRUS, inflation uncertainty, output market uncertainties, investment strategy and technology all correlate with the investment category at the 5%-significance level; the size of an organization is correlated with the capital budgeting category at the 1%-level. The table also reveals that almost all uncertainties are positively correlated with each other; as a result, all uncertainties are positively correlated with the BRUS. Also, the other contingency factors (technology, investment strategy and size) hardly correlate with the BRUS or other specific uncertainties.

An interesting point is the negative correlation between size and output market uncertainty (significant at the 5% level). This suggests that large organizations may have some market power, i.e. that large organization may have some degree of influence on output market conditions. These results correspond with the observation by Kotler ([1988], p. 319), who states that most industries contain one organization that is acknowledged as the market leader. This organization has the largest market share in the relevant product market and usually leads the other firms in price changes, new-product introductions, distribution coverage and promotional intensity.

Also interesting is the positive relation (at the 1%-level) between technology and liability uncertainty. One potential explanation is that the application of new technologies may result in additional liability claims due to the fact that the new products or production processes do not perform or operate as expected.

The (non-significant) negative correlation between the BRUS[45] and the investment strategy suggests that the adoption of an insurance investment strategy indeed reduces uncertainty. This observation is internally consistent, since the objective of an insurance approach is to reduce uncertainty by committing to multiple investments

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43 The results from the Pearson correlation are similar to the results of the Spearman correlation and the Kendall correlation.

44 The binary variables derived at the beginning of this section have been used. The results from a correlation analysis based on the "original variables" (uncertainty factors, measured on a 5-point Likert scale; and size, measured by asset size) are mostly similar to the results for the "binary variables" presented here.

45 The relation between RUS and the investment strategy is also negative (results not presented here).

that guarantee a return to the organization under all foreseeable future eventualities.

The correlation analysis also suggests that "financial uncertainties" are correlated with each other. The "financial uncertainties" include exchange rate uncertainty, interest uncertainty, inflation uncertainty and credit uncertainty. The correlation between these uncertainty factors is high (P<5%). Credit uncertainty is also associated with some "non-financial uncertainties": credit uncertainty correlates with output market uncertainty and behavioral uncertainty (both at the 1% significance level). The other "non-financial uncertainties" hardly seem to be related, although behavioral uncertainty is correlated with liability uncertainty (at the 5% significance level).

5.5.5 Interrelations between Determinants of Capital Budgeting Practices

To investigate the interrelationships between the determinants of capital budgeting practices, a factor analysis was executed. The relation between the BRUS and the other determinants of investment practices (size, technology and investment strategy) has been analysed. The next table represents the results for the factor analysis.

Total Variance explained			
	Initial Eigenvalues		
Component	**Total**	**% of Variance**	**Cumulative %**
1	1.157	28.9	28.9
2	1.039	26.0	54.9
3	0.985	24.6	79.5
4	0.819	20.5	100.0
Extraction method: Principal Component Analysis			

Table 5.34: *Factor analysis results for determinants of investment practices*

Table 5.34 reveals that all eigenvalues are close to 1: the initial eigenvalues range from a minimum of 0.819 to a maximum of 1.157. Considering these values, it is hardly possible to combine several factors in one component[46]. Therefore, it is decided to recognise these four factors ([B]RUS, investment strategy, size and technology) as separate factors that have an impact on capital budgeting practices. Size, uncertainty and - to a lesser extent - technology (represented by industry code) have also been recognized as determinants of capital budgeting practices in previous re-

[46] If the factor analysis is based on the Likert-scores for the variables where possible (size, uncertainty), the results are similar to the results presented in table 5.34 (results not presented here).

search projects (e.g. Ho & Pike [1992]; Haka et al [1985]). However, researchers have not yet identified investment strategy as an important determinant of capital budgeting practices. The results are presented graphically in the next figure.

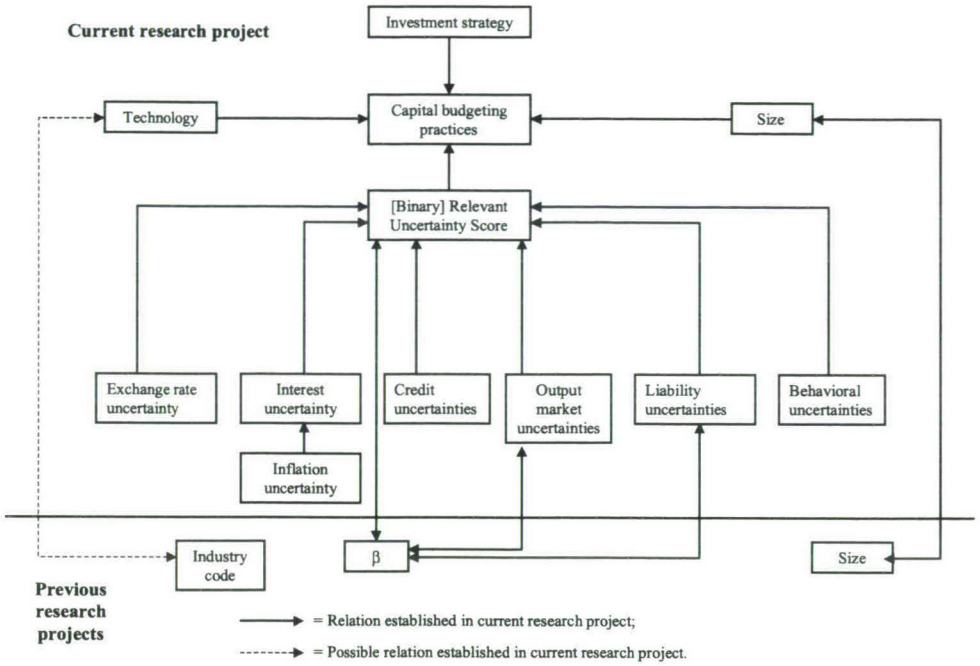

Figure 5.35: *"Multiple contingency profile" for capital budgeting decision making*

The previous figure graphically presents the results for the determinants of capital budgeting practices. In addition to the impact of the specific uncertainties (combined in RUS or BRUS), it also displays the impact of size, technology and investment strategy (the "multiple contingency profile"). Finally, the relations between the determinants of capital budgeting practices from this research project and the factors identified in other research projects are depicted.

5.6 Summary and Conclusions

In this chapter, an analysis of the determinants of capital budgeting practices in decision-making context has been provided. First of all, the current state of capital budgeting practices in the Netherlands has been portrayed. In the past 25 years, the usage of discounted cash flow methods and the application of uncertainty analysis has increased (or at least stabilized) in the Netherlands. Also, organizations in the Netherlands generally use a number of methods to evaluate in which project to invest. These results are in accordance with trends observed in other Western countries (US, UK, European Union). The "application rate" of several selected methods and techniques is similar to those in other Western countries. Therefore, it is expected that the results of this research project may be generalizable to large organizations in other Western countries.

Organizations are classified as simple risk adjusters (SRA), probability risk adjusters (PRA) or game/option theory adjusters (GOTA) on the basis of the survey results. SRA-users do not use all available information with regard to cash flows, do not consider present values and/or do not deal with uncertainty in any systematic manner. PRA-users do use cash flow information, consider present value and analyze and deal with uncertainty in a systematic manner. GOTA-users have a similar profile as PRA-users; in addition, they use real option price theory and/or game theory in investment decisions. The last two groups (PRA and GOTA) are classified as organizations that use advanced capital budgeting practices (ARA-users). About 54% of the respondents is classified as SRA-user, 37% is PRA- and about 9% of the respondents is GOTA-user on the basis of previous criteria. It should be noticed that the definition of advanced capital budgeting practices (i.e., ARA-users) is different from the definitions used in some other capital budgeting surveys. Previous studies have defined organizations that use DCF-methods in capital budgeting as "advanced"; in this study, organizations have to deal in a systematic manner with uncertainty to be classified as "advanced". In addition, the classification of organizations is not mutually exclusive, but refers to the most advanced techniques used within the organization. Organizations seem to apply *more* capital budgeting practices as uncertainty increases rather than *different* capital budgeting practices

Next, the impact of uncertainty on capital budgeting practices has been determined. First of all, there are three constituent components of uncertainty: one factor is an "all-purpose uncertainty factor", the second separates "supra-industry uncertainties" from "industry/organization uncertainties" and the third distinguishes among a "financial/output uncertainty component" and a "qualitative societal/policy uncertainty component". Second, the results presented in this chapter suggest that an increase in uncertainty is associated with the application of sophisti-

cated capital budgeting practices. More specifically, an increase in exchange rate uncertainties, interest rate and inflation uncertainties, output market uncertainties, liability uncertainties, credit uncertainties and behavioral uncertainties is associated with the application of advanced capital budgeting decision making. These uncertainties are mostly associated with the "financial price/output uncertainty factor" from the three constituent parts of uncertainty. Third, it is possible to derive a "[binary] relevant uncertainty score" ([B]RUS) for the previous uncertainties relevant to capital budgeting practices. An increase in [B]RUS is associated with the application of sophisticated capital budgeting practices (significant at the 1-%-level). Also, the results from this study suggest that the sophistication of capital budgeting practices includes more than just the application of DCF-methods.

In addition to uncertainty, the relations between several other contingency factors (environment, technology, strategy, size and industry) have been investigated. These contingency factors have been derived from capital budgeting literature. It appears that technology, investment strategy and size are related to capital budgeting practices; for other factors, it has not been possible to test the previous relation (environment, industry) or a relation was not established (goals and objectives, corporate strategy, business unit strategy). The generic typology of strategy that has been used may not be the proper level of measurement to establish relations between strategy and capital budgeting practices. A more in-depth analysis on the relation between specific elements from strategy (e.g., familiarity; formalization) and capital budgeting practices is an area for future research. In the next table, the results for the hypotheses 1 through 13 are presented.

Hyp	Expectation	C/D	Remarks
1	Similar trends in CB practices as in other Western countries	C	
2	Similar application rates for CB practices in Netherlands as in other countries	C	
3	Increase in total uncertainty is related to application of more advanced CB practices	C	Not related to DCF-methods alone, but to CB practices in general (dealing in a systematic manner with uncertainty)
4	Increase in specific uncertainties is related to application of more advanced CB practices	C	Relevant uncertainties to CB: exchange rate uncertainties, interest rate uncertainties, inflation uncertainties, credit uncertainties, output market uncertainties, liability uncertainties, behavioral uncertainties
5	The dynamism of the environment is related to CB practices	NT	
6	The heterogeneity of the environment is related to CB practices	NT	
7	Increase in technological change is related to advanced CB practices	C	Relation with industry code
8	Objectives of an organization have an impact on CB practices	D	Profit is important to all firms; other objectives seem to be subdued to the profit objective
9	Corporate strategy has no impact on CB practices	C	Future research: analysis of relation between elements of corporate strategy and CB practices
10	Business unit strategy has no impact on CB practices	C	Future research: analysis of relation between elements of business unit strategy and CB practices
11	Investment strategy is related to CB practices	C	Insurance approach is related to sophisticated CB practices, incremental approach is related to simple CB practices
12	Increase in size is related to advanced CB practices	C	
13	Industry has an impact on CB practices	NT	Industry is proxy for technological change

Hyp = number of hypothesis (see chapter 3);
C = confirmed;
D = denied;
NT = not testable.

Table 5.36: *Results for hypotheses*

It is possible to derive a "multiple contingency profile" relevant for capital budgeting practices on the basis of previous results. In addition to the relevant uncertainties recognized previously, the "multiple contingency profile" also recognizes the impact of the other contingency factors (size, investment strategy and technology). The internal consistency of the multiple contingency profile has been investigated: it appears that [B]RUS, size, investment strategy and technology are separate determinants of capital budgeting practices. A comparison between β and [B]RUS indicates that these two measures for uncertainty are related; however, β seems to reflect some specific uncertainties (output uncertainty, liability uncertainty) while

[B]RUS encompasses the uncertainties relevant to capital budgeting practices. In addition to that, β is an ex post resultant of previous activities while the multiple contingency profile is an ex ante determinant of capital budgeting practices.

A comparison of the results from this study with previous research projects indicates that investment strategy and, to a lesser extent, (turbulence of) technology may be determinants of capital budgeting practices not recognized in previous research. In addition to that, the comprehension of the relation between uncertainty, other contingency factors and capital budgeting practices has been enhanced by the development of the "multiple contingency profile".

CHAPTER 6

CAPITAL BUDGETING PRACTICES AND PERFORMANCE

6.1 Introduction

In the previous chapter, the relation between uncertainty, other contingency factors and capital budgeting decision making has been investigated. Based on the survey results, a "multiple contingency profile" has been derived. The "multiple contingency profile" indicates that the capital budgeting practices of an organization are influenced by uncertainty, size, technology and investment strategy. In this chapter, it is evaluated whether the performance of organizations is impacted by the application of specific capital budgeting practices. It should be noticed that the relation between capital budgeting practices and financial performance is a tricky one: since profit is the residual of revenues and costs, the variance in profit is the sum of the variances in revenues and costs. In addition, profit is impacted by so many factors that it is probably hard to single out the effect of one variable (for example, an appropriate matching between uncertainty and capital budgeting practices; see Salamon [1982]). Thus, the increase in performance resulting from an appropriate matching of uncertainties, other contingency factors and capital budgeting practices is statistically hard to prove. This point is illustrated by the results of previous research projects that have investigated the relationship between the type of capital budgeting practices and firm performance (see table 6.1).

Author	Performance measure	Research method	Results
Chen [1995]	Return on assets	Comparison of ROA of two groups (high-use or low-use) of capital budgeting decision rules	No significant differences between ROA for each of the capital budgeting decision rules (DCF, payback, ARR and nonfinancial)
Ho & Pike [1992]	Corporate investment	Matched pairs approach - matching variables size, risk and industry	No significant relationship between sophistication of CB (DCF + formal risk analysis) and corporate investment
Ho [1992]	Operating return measures	Matched pairs approach - matching variables size, risk and industry	No significant relationship between sophistication of CB (DCF + formal risk analysis) and performance
Haka et al [1985]	Share price	Matched pairs approach - matching variables size, risk and industry	No significant relationship between sophistication of CB (DCF) practices and firm performance
Kim [1982]	Average earnings per share	Multiple regression: independent variables- degree of sophistication of capital budgeting process, size, risk and capital intensity	Positive relationship between degree of sophistication of CB process, DCF-methods, firm performance, size and risk
Klammer [1973]	Operating rate of return	Multiple regression: independent variables- capital budgeting techniques, size, risk, capital intensity	No significant relationship between profit performance and the use of advanced capital budgeting practices (DCF)

. ***Table 6.1:****Previous research on capital budgeting practices and performance*

Table 6.1 indicates that previous studies have hardly found a relation between capital budgeting practices and performance. It is important to notice several differences between the studies: for example, some projects have relied on cross-sectional comparison of performance (Kim [1982]; Klammer [1973]), while other have used a matched pairs approach (Ho & Pike [1992]; Ho [1992]; Haka et al [1985]). Also, different studies have employed different performance measures such as operating rate of return (Klammer [1973]; Ho [1992]), share price (Haka et al [1985]) or corporate investment (Ho & Pike [1992]). Finally, several definitions of capital budgeting practices have been used: some studies have defined the application of discounted cash flow method as advanced (Haka et al [1985]; Schall & Sundem [1980]; Klammer [1973]), while others argue that the application of uncertainty analysis is necessary to qualify as "sophisticated" (Ho & Pike [1992]; Kim [1982]).

Considering the lack of a relationship between the sophistication of capital budgeting practices and performance in most previous research projects, a number of methods have been used to investigate the relationship between the variables under consideration. The use of several methods is prompted by the explorative nature of this research project; each method focuses on different aspects of the relation between capital budgeting practices and performance. Three methods are used to study the relation between contingencies (especially uncertainty), capital budgeting practices and performance:

- *Interaction approach*: the interaction approach focuses on the explanation of variations in performance from the interaction between capital budgeting practices and uncertainty;
- *Matched pairs approach*: the matched pairs approach compares the performance of two fairly similar organizations (with regard to, among other things, uncertainty) that apply different capital budgeting practices;
- *Systems approach*: the systems approach analyzes whether there are "contingency paths" (uncertainty, capital budgeting practices, size, etc) that affect performance.

These approaches have been discussed in some detail in chapter 3.

6.2 Variables under consideration

6.2.1 Uncertainty

This research is focused on decision makers' perceptions of the uncertainty in their environment rather than on "objective" measures of uncertainty. The instrument used to measure uncertainty is Miller's [1992] uncertainty framework (see chapter 3). For the matched pairs approach, a three-step procedure has been followed to derive a binary relevant uncertainty score ("binary RUS"). First, the uncertainties that influence capital budgeting practices (see chapter 5) have been selected. Next, the Likert-scores on these uncertainties have been divided into two groups: a low impact group (score 0) and a high impact group (score 1). In the third step, the sum of these binary scores has been determined. The BRUS has been used to obtain a "sharp" profile: it prevents that different scores "offset" one another (i.e., a "3+3 score" is equivalent to a "5+1 score"; see also section 5.4). The "original" relevant uncertainty scores (i.e., the RUS based on the original responses on the Likert-scale) have been used for the interaction- and the systems approach. For these last two analyses, a continuous measure such as RUS is deemed more suitable than a rather discrete measure (such as BRUS). Summary data of these measures are provided in *Appendix 6.1*.

6.2.2 Capital Budgeting Practices

Capital budgeting practices have been measured by two variables. For the matched pairs approach, two discrete capital budgeting typologies have been used: SRA-users and ARA-users (see chapter 5 for definitions). This recognition of two discrete typologies is similar to the other research on matched pairs (Ho & Pike [1992]; Haka et al [1985]). For the purposes of the interaction- and the systems approach, the sophistication of capital budgeting practices has been conceptualized as a continuous variable (similar to Gupta & Govindarajan [1984]).

The sum of the scores on the application of uncertainty analysis-, uncertainty adjustment techniques and capital budgeting decision rules is used as a continuous variable that provides a measure for the sophistication of capital budgeting practices (see also figure 5.11). Summary data on capital budgeting practices are also provided in *Appendix 6.1.*

6.2.3 Performance measures

This study has used five performance measures: two financial, objective measures (return on equity, ROE, and return on assets, ROA) and one non-financial, subjective measure (effectiveness). In addition to that, uncertainty-adjusted performance measures (the reward-to-variability-ratio, RTVR, for ROE and ROA; see section 4.3.4 for definitions) have been derived. The financial and non-financial performance measures are discussed separately.

Financial performance

The financial performance is derived from the REACH CD-Rom database. In some instances, the ROE and ROA had to be replaced by the measure return on owners capital, respectively the return on total assets due to the unavailability of ROE and ROA. The summary statistics for the financial performance measures (ROE, ROA, $RTVR_{ROE}$ and $RTVR_{ROA}$) are presented in *Appendix 6.1.* The results indicate that the standard deviations for the financial performance measures are fairly large in relation to their mean. This is due to the fact that outliers may be included (see the minimum and maximum values for the financial performance measures).

Effectiveness

Appendix 6.1 also provides an overview of the effectiveness of all organizations (compared to superiors' expectations) along various performance criteria. The summary data indicate that the average effectiveness for organizations is 3.38 (on a 5-point

Likert-scale). Given the exclusive reliance on self-assessment to measure effectiveness, the effectiveness measure needs to be interpreted with some caution. The following evidence and/or arguments might be noted in support of this measure's validity (see Govindarajan & Gupta [1985], p. 657):

1. The summary data reveal that the responses on virtually all performance dimensions range from "not at all satisfactory" (minimum = 1.00) to "outstanding" (maximum = 5.00). A second look at the data on means, standard deviations, minimum and maximum learns that the respondents, as a class, cannot be characterized as having been lenient in assessing the performance of their own organizational unit;
2. In an earlier empirical study, Heneman [1974] has reported a very high correlation between superior and self-ratings in situations where the subordinate is guaranteed anonymity and understands that the objective of data collection is scientific research and not his personal evaluation from the organization's perspective. Heneman's conditions have been fully met in this study.

Based on previous analysis, it is concluded that the effectiveness performance index may be considered an adequate measure for performance.

6.2.4 Correlation between performance measures and other variables

In a first step, the correlations between the performance measures themselves as well as the correlations between the performance measures and other relevant variables (uncertainty, capital budgeting practices) is determined. The correlation results are presented in *Appendix 6.2.*

Appendix 6.2 indicates that there is no direct relation between neither uncertainty and any of the performance indicators used, nor between capital budgeting practices and any of the performance indicators used (P>.1). The first notion is interesting since previous research has indicated that the performance of "high uncertainty firms" surpasses the performance of "low uncertainty firms" (see Schipper [1998][47]; Klammer [1973]). The second notion is contrary to the results obtained by Kim [1982], who found a positive relation between corporate profitability and the degree of sophistication of the capital budgeting system. The difference between the results obtained by Kim [1982] and the results from this study may be due to dissimilarities in the definitions of sophisticated capital budgeting practices and performance measures. The lack of a direct relation between uncertainty and per-

[47] The lack of a relation between risk and return may be (partially) explained by the fact that Schipper [1998] used stock returns as a measure of performance, while this study uses accounting performance measures. Research has indicated that the choice of accounting risk and return measures has an impact on risk-return relationship for organizations (see Baucus et al [1993]).

formance in this study points out that variations in performance are largely due to intraorganizational factors. Finally, all performance measures are correlated at the 10%-level, with the exception of the correlation between $RTVR_{ROA}$ and the effectiveness measure (correlation=.07, P=0.6). The correlation between the performance measures adds credibility to the subjective performance measure (effectiveness). The correlation between the financial performance measure and effectiveness implies that the effectiveness measure is probably also vulnerable to the "variance problem" that may affect the financial performance measures (see section 6.1).

6.3 Comparison of Performance

In this section, the relation between uncertainty, capital budgeting practices and the performance of organizations is investigated through the three approaches mentioned previously.

6.3.1 Interaction approach

The propositions to be tested in the interaction approach are of the following form: the positive impact of S_2 (sophistication of capital budgeting practices) on Y (performance) will be stronger when S_1 (uncertainty) is high as compared to when S_1 is low. According to Govindarajan & Gupta [1985], the most appropriate analytical model to test such a hypothesis is to run the two regression equations given below:

$$Y = a_0 + a_1S_1 + a_2S_2 + \varepsilon_1 \qquad (1)$$

$$Y = b_0 + b_1S_1 + b_2S_2 + b_3S_1S_2 + \varepsilon_2 \qquad (2)$$

If the unstandardized regression coefficient b_3 is *positive and significant*, one can conclude that the positive impact of S_2 is indeed stronger for higher as compared to lower values of S_1. In that situation, the hypothesis that there is a positive relation between an increase in uncertainty, the application of sophisticated capital budgeting practices and performance is confirmed. Alternatively, a *negative and significant* b_3 would lead to the conclusion that the positive impact of S_2 on Y is stronger for lower rather than higher values of S_1. Such a result would indicate that the application of more sophisticated capital budgeting practices in situations of high uncertainty would result in a lower performance; in that case, the hypothesis can be rejected. Finally, if b_3 is not significantly different from zero, one would conclude that S_2 does not have any contingency effect on the relationship between S_1 and Y.

According to Govindarajan & Gupta [1985], the only utility of equation (2) is to learn about the significance and nature of the impact of interaction between S_1 (uncertainty) and S_2 (sohpistication of capital budgeting practices) on Y (performance). Equation (2) does not reveal any information on the nature of their main effects. If one is interested in learning about the main effects of S_1 and/or S_2 on Y, it is equation (1) that can be of some value. In addition, it should be noted that the results for S_1S_2 differ from the results for S_1 and S_2 due to the "multiplier effect" in S_1S_2. The results of the regression equations for capital budgeting practices, uncertainty and performance are presented in the next table.

Performance measure	Nr	Constant	S_1	S_2	$S_1 S_2$	F-ratio	P	R^2
ROE	1	13.40	-.48	.45		.33	.72	.01
		(.72)	(.72)	(.45)				
	2	5.31	-.12	.63	-.01	.22	.88	.01
		(.97)	(.98)	(.84)	(.95)			
RTVR ROE	3	.98	.04	-.01		.08	.93	.003
		(.69)	(.71)	(.88)				
	4	-3.35	.23	.09	-.004	.13	.94	.006
		(.72)	(.58)	(.66)	(.63)			
ROA	5	6.91	-.10	.08		.41	.67	.01
		(.33)	(.69)	(.41)				
	6	-7.54	.56	.41	-.01	.39	.76	.02
		(.77)	(.63)	(.46)	(.56)			
RTVR ROA	7	-1.99	.06	.01		.23	.80	.007
		(.47)	(.52)	(.90)				
	8	-19.39	.86	.40	-.02	1.35	.26	.06
		(.05)	(.05)	(.06)	(.06)			
Effectiveness	9	3.32	.002	.001		.06	.94	.01
		(.00)	(.82)	(.85)				
	10	4.39	-.04	-.02	.001	.59	.62	.01
		(.00)	(.24)	(.22)	(.20)			

NB: Variables were coded as follows: S_1 = uncertainty; S_2 = sophistication of capital budgeting practices; Y = performance.

Table 6.2: *Results of multiple regression analysis with performance as dependent variable*

The results in table 6.2 reveal that none of the independent variables (uncertainty, S_1; sophistication of capital budgeting practices, S_2) has a direct impact on performance ($R^2 < .02$; equations 1, 3, 5, 7 and 9; see also *Appendix 6.2*). If anything, the findings suggest a negative (but non-significant) relation between uncertainty and performance, and a positive (but non-significant) relation between the sophistication of advanced capital budgeting practices and performance. The rather low R^2 is in concordance with previous research on contingency relations (Govindarajan & Gupta [1985]; Drazin & Van de Ven [1985]).

An examination of the relation between uncertainty, capital budgeting practices and performance provides mixed results. The results for financial performance measures (ROE, $RTVR_{ROE}$, ROA and $RTVR_{ROA}$) indicate that the relation between uncertainty, advanced capital budgeting practices and performance is negative, which is contrary to expectations, but not statistically significant (significance of variables >.10; significance of model >.65; R^2 <.02, with the exception of $RTVR_{ROA}$: significance of variables>.04; significance of model: .26; R^2=.06). The findings for effectiveness (equation 10) are in concordance with the hypothesis, but are not significant (.19<significance of variables <.25; significance of model: .62; R^2=.01). The results for effectiveness suggest that the application of advanced capital budgeting practices results in a higher effectiveness as uncertainty increases – which is in contrast with the results for financial performance. It is concluded that the findings from the interaction approach do not provide a clear picture on the relation between uncertainty, capital budgeting practices and performance.

6.3.2 Matched pairs approach

One of the approaches in this study matches an organization that uses sophisticated techniques (PRA- or GOTA-user, an experimental organization) with one using naive techniques (SRA-user, a control organization) and compares the performance of these organizations over the same time period. Previous research has identified three factors that have an impact on capital budgeting practices of organizations: industry, size and uncertainty (see Ho & Pike [1992]; Haka et al [1985]; Harrison et al [1983]). These three factors have also been identified as determinants of capital budgeting practices in the previous chapter; in addition, the investment strategy of an organization also has an impact on capital budgeting practices and has been used as another matching variable in this study. Thus, organizations in this research sub-project have been matched on an additional variable (investment strategy) in comparison to previous research projects.

Matching procedure

The survey results have been used to obtain a set of matched organizations. Experimental organizations (i.e., ARA-users) and control organizations (SRA-users) both were selected from the pool of survey respondents. The questionnaire approach ensured that a large sample size, representing different industries, could be included in the study. To qualify as "experimental", an organization has to apply advanced capital budgeting practices on a structural basis (i.e., qualify as ARA-user). Organizations that use relatively simple capital budgeting practices qualify as "control" organizations (i.e., qualification as SRA-user). The selection criteria used for matching organizations include industry code, size, investment strategy and un-

certainty (see previous chapter). For additional information purposes, the technology code is also presented in the tables; however, technology has not been a separate selection criterion in the matching of organizations since industry is expected to provide a measure for the turbulence of technology (see chapter 5).

Appendix 6.3 provides information on the quality of the matching process for both effectiveness as well as financial performance. The matching is based on the ratios for the criteria; for example, the matching ratio for size is calculated by dividing the asset size of the control organization by the asset size of the experimental organization. The closer the matching ratio is to one, the better the two organizations are matched on that variable. *Appendix 6.3* indicates that it has been possible to match 29 organizations with regard to effectiveness and 20 organizations with regard to financial performance. The sample size for effectiveness is larger than the sample size for financial performance, since it is not necessary to use public databases to obtain effectiveness results. That is, it is possible to derive the effectiveness from the survey results without knowing the name of the organization. The financial industry (banks, insurance companies) has been excluded from a comparison of financial performance because of the impact of their financial asset base on the financial performance measures.

Discussion of matching criteria

Each of the matching parameters used is discussed briefly; also, some remarkable matching ratios are explained. All matched pairs are included in the (primary) analysis.

- **Industry/technology**

  Organizations with similar industry codes are operating in one industry and are expected to face similar investment environments and opportunities (see Ho & Pike [1992], p. 393). Also, industry code is expected to be an indication for technology (see previous chapter). For the purposes of this analysis, all matched organizations operate within the same industry. Respondents have been asked to characterize the technology of their organizational unit as fertile (1), turbulent (2) or stable/long-lived (3). Research results presented earlier in this thesis suggested that organizations with turbulent technologies are more inclined to apply advanced capital budgeting practices. Therefore, a match of turbulent technology with stable/long-lived technology (a score of 2 vs. 3, or 3 vs. 2) or turbulent technology with fertile technology (a score of 1 vs. 2, or 2 vs. 1) should be avoided.

Four matches for financial performance and effectiveness[48] do not fit this "rigid technology criterion". It is possible that this "mismatch" accounts for differences in performance of the matched organizations. However, it is assumed that the industry code gives an ample representation of the technology used in the business activities of organizations.

- **Size**
  This research project as well as other research projects have established that size is a major determinant of capital budgeting practices (see previous chapter). Total assets (book value of all equity and debt of the organization) has been used as a measure of size. The size criterion used is that organizations had to have an asset ratio between 0.20 and 5.00 (i.e., one organization is at the most 5 times as big as its counterpart). A similar size criterion has been used in several previous studies (see Ho & Pike [1992]; Haka et al [1985]). All matched organizations fit this criterion. However, *Appendix 6.3* reveals that the experimental organizations (ARA-users) are somewhat larger than the control organizations (SRA-users): the size ratio is smaller than one for about 75% of the matches[49]. Considering that the size ratio is determined by dividing the size of the control organization by the size of the experimental organization, it is concluded that ARA-users are generally larger than SRA-users. This observation is consistent with the conclusion that, in general, large organizations apply more advanced capital budgeting practices than smaller organizations do. Considering the fact that all organizations fit the "size ratio criterion" (0.2< size ratio < 5), it is assumed that this factor by itself is not an explanation for a possible difference in performance.

- **Investment strategy**
  Organizations can pursue an insurance approach (identified by 1), dedicated approach (2), incremental approach (3) or opportunistic approach (4) in the investment decision (see Collis [1992]). An insurance approach is associated with more advanced capital budgeting methods (ARA-user), while an incremental approach is associated with relatively simple capital budgeting practices (SRA-user). The "investment strategy criterion" used in this matched pairs approach holds that within one match, one organization cannot pursue an insurance approach while the other organization pursues an incremental approach (i.e., a "1 versus 3 match" must be prevented). All matches fit the "rigid investment strat-

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48 There are no data on technology available for one of the organizations in the effectiveness match. Therefore, it is possible that five organizations do not fit the "rigid technology criterion" presented here.

49 Other studies have also suffered from this problem, although less dominant. For example, the asset size of 60% of the experimental organizations exceeds the asset size of the control organizations in the study by Haka et al. [1985]; this percentage is 52% in the study by Ho & Pike [1992].

egy criterion" for effectiveness; one matched pair does not fit this criterion for financial performance.

- **Uncertainty**
  In the matched pairs approach, the "binary RUS" has been used: the score for the binary RUS can vary between 0 and 7[50] (see *Appendix 6.1*). The difference in the binary RUS for a match should preferably be smaller than 2; also, matched organizations should preferably be in the same uncertainty group. Organizations with a binary RUS below 3 are labeled "low uncertainty organizations"; organizations with a binary RUS over 4 are labeled "high uncertainty organizations". For effectiveness, there are 4 matches that do not fit this "rigid uncertainty criterion"; 8 matches in the financial performance sample do not fit this criterion.

In general, there seems to be a fairly good match of paired organizations. Further, any individual matching disparities should be "neutralized" when the organizations are considered as portfolios of experimental and control organizations (see Haka et al [1985]). A comparative analysis of the experimental and control organizations on selected attributes (total assets, sales, number of employees) indicates that there are no statistical differences on these attributes ($P>.05$), with the exception of uncertainty. The BRUS is higher for ARA-users than for SRA-users ($P=.02$); considering the classification criteria developed in chapter 5, this is not surprising. Uncertainty thus seems to be the most difficult matching criterion. However, the differences in β (a measure of uncertainty) have also been fairly large in previous research projects (see Ho & Pike [1992]; Haka et al [1985]).

Considering the relatively small differences between the uncertainty scores of the matched pairs (all pairs do not differ more than two points in their BRUS score for effectiveness; 4 pairs differ more than 2 points for financial performance) and the fact that the majority of matched pairs fits within one uncertainty group (with the exception of 4 matched pairs for effectiveness and 8 for financial performance), it is expected that these differences in uncertainty are acceptable. In addition to that, all tests have been repeated by matches that does fit all previous criteria (industry, technology, size, investment strategy and uncertainty group); if the results for these tests are different from the results for the sample previously described, they are discussed separately.

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50 The range of possible values for the "uncertainty profile" indicates that at least 35% of the "financial performance group" and at least 40% of the "effectiveness group" is matched on the majority of uncertainty factors. These percentages are probably higher.

Comparison of performance of matched pairs

The matched pairs approach compares the (difference in) performance of matched organizations in two groups: a "low-uncertainty" and a "high-uncertainty" group. The propositions to be tested in this section are of the following form: the performance of ARA-users (SRA-users) is higher that the performance of SRA-users (ARA-users) when uncertainty is high (low). This hypothesis is tested by the following equation:

$D_{t,j} = P^{ARA}_{tj} - P^{SRA}_{tj}$, where t = 1, ...,n; and j = 1, ...,29.

The paired sample t-test is used to test whether the difference in performance, D_{tj}, between the two matched organizations in one group is statistically significant. In addition to that, the non-parametric alternative for the paired-sample t-test (the Wilcoxon signed-rank test) is used to confirm the findings. The next table presents the results for the relation between uncertainty, capital budgeting practices and performance.

Performance measures	Nr.	Uncertainty	SRA-user	ARA-user	t-value	Probability
ROE	1	Low	10.87	25.46	-1.06	.32
	2	High	20.70	28.93	-.87	.41
RTVR $_{ROE}$	3	Low	.99	1.32	-.43	.68
	4	High	3.17	1.33	1.16	.28
ROA	5	Low	7.49	9.99	-.98	.35
	6	High	8.53	7.98	.27	.79
RTVR $_{ROA}$	7	Low	.37	1.12	-.57	.58
	8	High	.00	.65	-.94	.37
Effectiveness	9	Low	3.23	3.22	.04	.97
	10	High	3.42	3.28	1.01	.33

Table 6.3: *Comparison of performance of matched pairs*

Table 6.3 reveals that the test results are contrary to expectations in 7 out of 10 cases. It was hypothesized that SRA-users would outperform ARA-users in situations of low uncertainty; the findings indicate that this is true in only one situation (effectiveness, nr. 9). Neither do ARA-users outperform SRA-users in situations of high uncertainty: the findings indicate that this is true for only two cases (ROE, nr. 2; and $RTVR_{ROA}$, nr. 8). None of these results is significant; therefore, the matched pairs approach does not provide a clear picture on the relation between capital budgeting practices, uncertainty and performance, either.

6.3.3 Systems approach

The systems approach focuses on differences in pattern profiles and accounts for all variables (uncertainty, size, technology, etc.) as a set. Advocates of the systems approach assert that the understanding of relationships between variables can only advance by addressing simultaneously the many contingencies, structural alternatives, and performance criteria that must be considered holistically to understand organization design. Bivariate analysis of a given contextual factor (for example, uncertainty) with a organizational characteristic (for example, capital budgeting practices) cannot address this question (Drazin & Van de Ven [1985]). The idea is to measure the deviation, not from a single linear equation line but rather as a distance from the profile described as a point in an multi-dimension pattern.

A four-step procedure is used to analyze the systems approach to fit in this database (see Drazin & Van de Ven [1985]). First, all variables are recoded in ordinal variables[51]. Each variable is dichotomized into roughly equal categories representing low and high levels for the variable. For example, organizations were subdivided into two groups based on their relevant uncertainty score (RUS): one group has a low RUS score (1), the other group has a high RUS score (2). This action has been repeated for the other variables under consideration.

In the next step, the (expected) contingent relationships are expressed in ordinal variables. For example, uncertainty is presumed to be low (1) for SRA-users and medium to high (2) for ARA-users[52]. The next figure (an adaptation of figure 3.7) presents the hypothesized patterns for the three capital budgeting categories (SRA-, PRA- and GOTA-users).

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51 Some of the tests are repeated by using the "original" scores and the parametric tests. If the results are different, they are discussed separately.

52 Considering the relatively few number of GOTA-users, the tests have been conducted using both SRA- and ARA-users as well as SRA-, PRA- and GOTA-users.

		ARA-users	
	SRA-user	**PRA-user**	**GOTA-user**
Uncertainty			
3. Total Uncertainty	Low	Medium-high	High
Environment			
5. Dynamism	Low	Medium-high	High
6. Heterogenity	Low	Medium-high	High
Technology			
7. Turbulence of technology	Low	Medium-high	High
Objectives and strategies			
8.a Importance of profit, profit margin	Medium-High	High	Medium-high
8.b Importance of operational cash flows	Low	Medium-high	High
8.c Importance of dividends, shareholder value	Low	Low-medium	High
8.d Importance of cost reduction	High	Low-medium	Low
9. Corporate strategy	?	?	?
10. Business unit strategy	?	?	?
11. Importance of insurance investment strategy	Low	Medium-high	Medium-high
Size			
12. Size	Small	Medium-large	Large
Performance			
Financial performance/effectiveness (a)	High/low	High/low	High/low

(a): performance is expected to be high if pattern described is found; performance is expected to be low in case of other pattern.

Table 6.4: *Adjusted hypothesized patterns in capital budgeting practices*

To test whether the hypothesized patterns appear in practice, empirical ideal patterns are required. Empirical profiles are therefore generated for the 30 highest performing units, based on the effectiveness measure, representing SRA- and ARA-users (15 units for each level of uncertainty). In addition to that, the empirical profiles for ARA-users have been split in empirical profiles for PRA-users (15) and GOTA-users (5). The mean scores on these 30 units (respectively 35 units) on the relevant variables are considered as empirically derived ideal types, representing the best performing SRA- and ARA-users (PRA- and GOTA-users). The Anova-test has been used to test whether the empirical patterns actually differed. The results for these patterns are presented in *Appendix 6.4.*

The findings indicate that the organizational patterns for high-performing organizations are fairly similar to the profiles derived theoretically; however, the differences between the ideal patterns are fairly small. Statistically significant differences

are found for 4 out of 19 variables: output market uncertainty, the dynamism and heterogeneity of the environment and the importance of dividends/shareholder value. Contrary to expectations is that size, technology and investment strategy hardly differ among these groups.

Despite the relatively small differences in the patterns, it has been decided to use all variables in the pattern in the third step. This decision is based on the argument by Drazin & Van de Ven [1985] that relations between variables must reconsidered holistically to understand organization design. In this step, the difference between the "ideal patterns" and the "actual patterns" of the units are determined. For each organization, the squared difference between the "actual pattern" and the "ideal pattern" (based on the classification in SRA- or ARA-category) is calculated. The distance measure is calculated as follows:

$$DIST = \sqrt{\sum (X_{js} - X_{is})^2},$$

where X_{js} is the score of the jth organization on the sth variable and X_{is} is the score of the ideal organization on the sth variable. For the purposes of this project, two ideal patterns are used: the "empirical ideal pattern" described previously (represented by the empirical average values for the highest performing organizations) and the "theoretical ideal pattern" (i.e., the pattern represented by the expectations presented in table 6.4).

In the fourth step, a correlation analysis between the squared root of the sum of the squared differences and the performance measures is run. If the correlation between the squared root of the sum of the differences is negative and significant, one can conclude that the "ideal pattern" results in a higher performance. Fit, or perhaps more appropriately, misfit is demonstrated if the distance score is negatively correlated with the performance measures. The greater the distance from the respective ideal type, the lower the hypothesized performance. The results for the correlation analysis are presented in the next table.

	ROE	$RTVR_{ROE}$	ROA	$RTVR_{ROA}$	Effectiveness
Deviation from empirical SRA-profile	-.23	.19	-.16	.02	.05
	(.20)	(.30)	(.36)	(.91)	(.67)
Deviation from theoretical SRA-profile	-.01	.31	.03	.09	-.02
	(.96)	(.08)	(.86)	(.61)	(.84)
Deviation from empirical ARA-profile	-.08	.15	.15	.28	-.34
	(.71)	(.48)	(.51)	(.22)	(.01)
Deviation from theoretical ARA-profile	-.18	.11	-.13	-.10	-.34
	(.39)	(.58)	(.52)	(.62)	(.01)

Deviation from empirical SRA-profile = squared root of sum of squared difference between variable and empirical ideal pattern for SRA (empirical ideal pattern: RUS=1.33; dynamism=1.60; heterogeneity=1.80; technology=1.57; profit=1.40; OCF=1.20; dividends=1.33; costs=1.40; corporate strategy=1.40; business unit strategy=1.29; investment strategy=1.14; size=1.53).

Deviation from theoretical SRA-profile = squared root of sum of squared difference between variable and theoretical ideal pattern for SRA (theoretical pattern: RUS, dynamism, heterogeneity, technology, profit, costs, strategy, investment strategy and size=1).

Deviation from empirical ARA-profile = squared root of sum of squared difference between variable and empirical ideal pattern for ARA (empirical ideal pattern: RUS=1.60; dynamism=2.00; heterogeneity=2.00; technology=1.60; profit=1.67; OCF=1.40; dividends=1.73; costs=1.47; corporate strategy=1.40; business unit strategy=1.43; investment strategy=1.27; size=1.62).

Deviation from theoretical ARA-profile = squared root of sum of squared difference between variable and empirical ideal pattern for ARA (theoretical pattern: RUS, dynamism, heterogeneity, technology, profit, OCF, dividends, investment strategy, size=2).

Table 6.5: *Correlation between deviation from ideal pattern and performance*

The results for ROE and ROA are (mostly) in accordance with expectations (although not significant). The results for the RTVR's are all contrary to expectations (but not significant, either). The findings for effectiveness suggest that a deviation from the ideal SRA-pattern does not have any consequences for effectiveness; however, a deviation from the ideal ARA-pattern results in a lower effectiveness. An analysis of the scatter graphs (not included) does not reveal any additional insights. The systems approach does not result in new insights on the relation between uncertainty, other contingencies, capital budgeting practices and performance.

6.4 Summary and Conclusions

The relationship between uncertainty, capital budgeting practices and performance has been investigated empirically in this chapter. First of all, uncertainty has been measured by the subjective measure of uncertainty developed in the previous chapter. Capital budgeting practices have been measured by a continuous variable, as well as by the capital budgeting typologies (SRA- and ARA-users; the last group can be split in PRA- and GOTA-users) developed in the previous chapter. A number of performance measures has been used.

Two generally applied, objective financial performance measures (Return on Assets, ROA; and Return on Equity, ROE), as well as their uncertainty-adjusted equivalents (the reward-to-variability ratio, RTVR) have been utilized ($RTVR_{ROE}$ and $RTVR_{ROA}$; see section 4.3.4 for definitions). Finally, a non-financial, subjective performance measure (effectiveness) has been used. A correlation analysis reveals that the performance measures appear to be correlated.

Next, three methods have been used to investigate the previous relationship. The interaction approach focuses on the explanation of variations in performance from the interaction between capital budgeting practices and uncertainty. The matched pairs approach compares the performance of two fairly similar organizations (with regard to size, industry, investment strategy and uncertainty) that apply different capital budgeting practices. Finally, the systems approach analyzes whether there are "contingency paths" (interrelations between uncertainty, capital budgeting practices, size, etc.) that affect performance.

The findings from the analyses indicate that the hypotheses stated in chapter 3 (hypotheses 14-16) are not confirmed. That is, there appears to be no (significant) relationship between uncertainty, other contingency factors, capital budgeting practices and performance. Although disappointing, these findings are in accordance with most other research projects that investigated the relationship between capital budgeting practices and performance.

There are several reasons which may have affected the analysis and as such present limitations to this work; these limitations also present indications for future research in this area. The investigation of these limitations may provide additional insights in the relation between capital budgeting practices and performance. First, the financial performance measures used in this research project (ROA and ROE) are based on accounting data. This means that the performance measures are vulnerable to changes and differences in accounting principles. It has been assumed that accounting principles used within one industry are similar and stable over the relevant time period and that the results of organizations within one industry are comparable. However, the financial returns of organizations have not been adjusted to reflect similar accounting principles. In addition, due to the limited availability of data it has been necessary to use substitutes for ROA (proxy: return on total assets) and ROE (proxy: return on owner's capital). Third, the variability in profit is high in relation to its' size: the variance of profit is the sum of the variance in revenues and costs. Also, there are so many factors that affect the firm's accounting rate of return that it is difficult to single out one factor. Therefore, it is difficult to derive significant conclusions based on accounting data from two fairly small samples. The use of accounting data may be a reason for disturbance of the results. This problem

has been (partially) tackled through the inclusion of a non-financial performance measure (effectiveness) in this research project. Considering that profit is an important objective to most organizations (see section 5.3 of this thesis), it is probable that it also affects the effectiveness measure. It is noticeable that the results for the effectiveness measure are mostly in accordance with the hypothesis (even though the results are not always significant).

Another limitation is that even though this study controlled for risk, size, industry effects (technology) and investment strategy, there are several other factors that may have an impact on either performance or capital budgeting practices. Factors that have an impact on performance include factors such as adoption of new strategies, adoption of new technologies, entrance in new markets, a change in pricing and marketing tactics, reward structures, ownership structure, capital structure, etc. (see, for example, Chen [1995]; Haka [1987]; Larcker [1983]). Additional research on these factors and their interdependencies with the factors identified in this research project may enhance the understanding of the capital budgeting process.

A third limitation is caused by the fact that only net returns have been available for this research project. Grossman [1980] and Cornell & Roll [1981] have shown that a sensible (financial) asset market equilibrium must leave some room for analysis. Their models have been developed for the capital market, but may also apply to real investments. The authors mentioned make the assumption that information acquisition (which is necessary to reduce uncertainty in the investment decision) is a costly activity. The firm that utilizes costly information to perform investment analysis and acquire better estimates of future states of nature will outperform other firms who use less information. However, the better performance is measured in terms of gross returns; the net returns for both strategies are expected to be identical. For organizations, only the net returns have been available. The costs of the capital budgeting staff, computer programs, market research and sessions with accountants, lawyers, consultants and engineers are included in the annual result. This notion is consistent with research by Haka [1987]: her findings suggest that (the costs of) the provision of tools (time off, special advisors, classes, etc.) to originators of capital budgeting projects appear to be negatively related to the effectiveness of the organization. The lack of a relation between uncertainty, capital budgeting practices and performance seems to be in accordance with the previous empirical research results. To investigate whether there are differences in gross returns, additional information on the composition of the returns for the organizations is needed. It is expected that case studies are appropriate for additional research on this topic.

A fourth limitation stems from the fact that organizations may have gone broke or entered a situation of severe financial distress due to the materialization of uncertainties; these organizations are not included in this research project. Annually, about 2-3% of all business organizations goes bankrupt[53]; a higher percentage is probably confronted with the costs of financial distress. Financial distress can result in reorganizations, bankruptcy or liquidation, situations in which the organization would face substantial direct legal and other costs. Even if financial distress does not end in bankruptcy, the organization will still encounter a number of indirect costs. The indirect costs of financial distress result from higher contracting costs of the organization with its customers, its employees, and its suppliers (see Smith et al [1990], p. 369; Shapiro & Titman [1992]). Organizations that have gone bankrupt are not included in the survey, which may have disturbed the results. An analysis of the capital budgeting practices of bankrupt organizations and a comparison of these results with capital budgeting practices of "going concern" organizations may reveal whether the application of sophisticated capital budgeting provides some "protection" against bankruptcy (see Stulz [1996]). In addition, an analysis of the capital budgeting practices of organizations in turn-around situations may reveal whether the implementation of sophisticated capital budgeting practices may be one of the means for coping with economic stress (Haka et al [1985]).

[53] In 1995, 14,300 out of a total of 605,235 businesses (2.4%) were discontinued in the Netherlands. In 1996, these numbers were 13,000 out of 623,280 (2.1%). Source: Bedrijven in Nederland, 1998; Economische demografie en micro-economische statistiek/Bedrijven naar activiteit en grootteklasse. CBS, Voorburg/Heerlen, 1998.

CHAPTER 7

DISCUSSION AND CONCLUSIONS

7.1 Introduction

The (inter)relationship(s) between uncertainty, other contingencies, capital budgeting practices and performance have been investigated in this study. A preliminary analysis of literature has revealed that little is known of the interrelationships between these variables. Based upon this initial analysis of literature and previous research, the following central theorem for this thesis has been identified:

Does uncertainty (separately or in combination with other contingency factors) affect capital budgeting practices and, if so, does it have an impact on performance?

The theoretical framework developed in this study operationalizes the uncertainty framework by Miller [1992]. Previous research projects have utilized general ex post measures of uncertainty, such as β or the variability of earnings (see Ho [1992]; Haka et al [1985]; Kim [1982]; Klammer [1973]). Up until now, no study has explored which specific uncertainties (such as exchange rate uncertainties, output market uncertainties or liability uncertainties) affect capital budgeting practices. Also, few studies have investigated which other contingencies (size, investment strategy, technology) are related to capital budgeting practices. The "multiple contingency profile" developed in this research project identifies the specific uncertainty elements that affect capital budgeting practices, as well as the relationships between uncertainty and other variables that affect capital budgeting practices. As a result, organizations are provided with insight in the (ex ante) determinants of their capital budgeting practices instead of being confronted with an ex post resultant for uncertainty. In general, the results support the hypotheses developed in the previous chapters.

A summary of the findings of the study and some concluding comments are provided in this chapter. The next section provides a brief discussion of the theory developed in chapter 3 and summarizes the results of the study presented in chapters 5 and 6. In section 7.3, the recommendations for future research are presented. Finally, the major conclusions of the study are presented in the last section of this chapter.

7.2 Theory and Results

7.2.1 Theory

Contingency theory attempts to identify specific aspects of an accounting system that are associated with certain defined circumstances and to demonstrate an appropriate matching. One of these defined circumstances is uncertainty; in addition, other contingency factors (such as size, strategy and environment) have been investigated in this research project. Uncertainty has been defined in this study as the condition under which no numerical probabilities can be attached to the various alternative outcomes (see Knight [1921]). Uncertainty can stem from basically two sources: first, all the states of the world may be known, but it is impossible to assign probabilities to these states; second, neither the states of the world nor the corresponding probabilities are (all) known with certainty.

Capital budgeting practices are defined as the procedures, routines, methods and techniques used to identify investment opportunities, to develop initial ideas into specific investment proposals, to evaluate and select a project and to control the investment project to assess forecast accuracy.

The theory developed in this study argues that the application of capital budgeting practices will differ among organizations that have to deal with different levels of uncertainty. Organizations in uncertain environments are expected to use more sophisticated capital budgeting practices (i.e., use uncertainty identification and uncertainty measurement methods on a structural basis, adjust for uncertainty and base their decisions on investment rules that account for uncertainty). Organizations in rather certain environments are expected to use rather simple capital budgeting practices (i.e., hardly use uncertainty identification and measurement methods, hardly adjust for uncertainty and hardly use capital budgeting decision rules that account for uncertainty). The sophistication of capital budgeting practices has been operationalized by the intensity of the application of several methods and techniques used in the capital budgeting process. Also, it has been noted that uncertainty may not influence capital budgeting practices by itself, but in relation with other contingency factors: there may be

"patterns of consistency" for the application of sophisticated capital budgeting practices. The (hypothesized) relationships in the previous theoretical framework are formalized in a number of hypotheses (see figure 3.8).

7.2.2 Results

Survey results

The hypotheses for the study have been tested by analyzing the results from a survey in 189 large Dutch organizations. Contract analysis, analysis of projected balance sheets and income statements of the investment project, analysis of the environment and interaction with other organizational units and external advisors are most important in identifying uncertainties in the investment project under consideration. Other uncertainty identification techniques (such as on-site inspections, analysis of statistical records and flow chart methods) are considered less useful in the capital budgeting process. Sensitivity analysis/break-even analysis and scenario analysis are the most commonly applied uncertainty analysis techniques; more advanced uncertainty analysis techniques (such as Monte Carlo simulations, decision trees and CAPM-analysis/β-analysis), although highly developed in theory, have not been widely accepted by practitioners.

The adaptation of the required rate of return (or discount rate) and the payback period is used most often to account for uncertainty in the capital budgeting process. Other uncertainty adjustment methods, such as risk absorption, adjustment of expected values or usage of certainty equivalents, are hardly used in practice. Also interesting is that a (rather large) minority of the organizations does not adjust for uncertainty on a regular basis. Finally, the payback, net present value and internal rate of return are the capital budgeting decision rules most frequently used by respondents. Relatively new and more advanced capital budgeting techniques, such as real option pricing theory and game theory decision rules, have not been widely accepted by practitioners. Some non-financial decision rules such as market share and strategic criteria are considered important in the investment decision process. The trends observed in other Western countries (high and increasing or stable "application percentage" of DCF-methods, increase in or at least stabilization of application of uncertainty analysis in capital budgeting, combination of appraisal methods) are also discernable in the Netherlands. The "application percentages" of the different methods and techniques in capital budgeting practices in the Netherlands are similar to the "application percentages" in recent surveys in other parts of the world (i.e., other European countries and the USA).

Classification of organizations

The survey provides the data for a classification of organizations based on the sophistication of capital budgeting practices. The qualifications Simple Risk Adjuster (SRA), Probability Risk Adjuster (PRA) and Game/Option Theory Adjuster (GOTA) have been used to signify an increase in the sophistication of capital budgeting practices. The classification criteria are based on the structural application of uncertainty analysis, uncertainty adjustment and capital budgeting decision rules. Uncertainty identification is not used as a classification criterion, since most respondents apply one or more uncertainty identification technique(s) on a regular basis. The next table presents the results from the classification process.

Classification of respondents	Criteria used					Percentage of organizations
	Uncertainty Analysis	Uncertainty adjustments	Accounting decision rules	DCF-decision rules	ROPT/ Game theory decision rules	
SRA	Rare-often	Rare-often	Often-always	Never-rare	Never-rare	54.3%
PRA	Often-always	Often-always	Often-always	Often-always	Never-rare	37.2%
Unclassified (GOTA)	Regular-often	Regular-often	Often-always	Often-always	Often-always	2.1%
GOTA	Often-always	Often-always	Often-always	Often-always	Often-always	6.4%
Total						**100.0%**

Table 7.1: *Classification of organizations*

The previous classification process results in 103 (54.3%) SRA-, 70 (37.2%) PRA- and 12 (6.4%) GOTA-users. The established criteria make it difficult to classify 4 organizations (2.1%). Considering that the characteristics of the last group are similar to those of the GOTA-users, it has been decided to classify them as GOTA-users. The classification criteria result in a classification based on the most advanced techniques used, rather than in mutually exclusive categories (see next table).

Techniques used	SRA-user	PRA-user	GOTA-user	F	P
SRA-techniques used	17.62	20.91	22.15	22.58	0.000
PRA-techniques used	15.09	19.63	24.62	58.64	0.000
GOTA-techniques used	5.86	6.89	12.00	40.22	0.000
Total number of techniques used	38.72	47.28	58.77	56.66	0.000

The scores for each classification group are calculated by summarizing the scores on the application of techniques:
SRA-techniques = Sensitivity/break-even analysis, scenario analysis, adaptation of payback period/required return, payback period, accounting rate of return (minimum score = 6, maximum score = 27);
PRA-techniques = Monte Carlo simulations, CAPM-/β-analysis, risk absorption in cash flows, adjusting expected values, profitability index, internal rate of return, net present value (min = 7, max = 31);
GOTA-techniques = Decision trees, certainty equivalents, real option pricing, game theory decision rules (min = 4, max = 18).
Total number of techniques used = sum of all scores on uncertainty analysis, adjustment and decision rules (min = 17, max = 75).

Table 7.2: Relationship between number of techniques and classification of respondents

The previous table indicates that SRA-users hardly use PRA- or GOTA-techniques. PRA-users use SRA- and PRA-techniques, but do not use GOTA-techniques intensively; and GOTA-users use SRA-, PRA- and GOTA-techniques. The data also indicate that the classification used in this thesis also provides an indication of how many uncertainties techniques are used in capital budgeting. Apparently, organizations apply *more* capital budgeting practices as uncertainty increases rather than *different* capital budgeting practices.

It should be noticed that the classification used in this thesis is different from the classification of organizations in other research projects (Ho & Pike [1992]; Haka et al [1985]; Schall & Sundem [1980]). In the previous research projects, only two groups have been identified: organizations using "advanced" capital budgeting practices (generally, the application of discounted cash flow methods, sometimes in association with uncertainty analysis) and "naive" capital budgeting practices (the application of payback or accounting rate of return and intuitive adjustments for uncertainty). The results from these studies have often been inconclusive or contrary to expectations, which may be related to the classification of respondents. The recent developments in discounted cash flow- and uncertainty analysis software are such that the application of these tools solely should not be used to point out "advanced organizations"; for example, about two thirds of the respondents would qualify as "advanced" if the DCF-criterion would have been used. An additional criterion in this study is that "advanced organizations" should also recognize the fact that certain cash flows are preferred to uncertain cash flows (i.e., adjust for uncertainty in the investment decision). In addition to that, fairly recent developments in capital budgeting selection rules (real option pricing theory, game theory) have made the recognition of a new group (GOTA-users) possible. The recognition of a

new classification group (GOTA) and the "stricter" classification criteria used for PRA-users (defined as organizations that identify, analyze and adjust for uncertainty in a structural manner *and* consider discounted cash flow techniques (very) important) provide more conclusive results on capital budgeting practices.

Impact of uncertainty and other contingency variables on capital budgeting practices

In addition to portraying capital budgeting practices, this thesis also reports the results of the impact of several variables (uncertainty, other contingency variables) on the application of advanced capital budgeting practices. The findings presented in this thesis suggest that an increase in uncertainty is associated with sophisticated capital budgeting practices. More specifically, an increase in specific uncertainties (exchange rate, interest rate and inflation uncertainties; output market uncertainties; liability, credit and behavioral uncertainties) is associated with the application of advanced capital budgeting decision making.

It is possible to derive a "(binary) relevant uncertainty score" ([B]RUS) for the previous uncertainties relevant to capital budgeting practices. It appears that an increase in [B]RUS is associated with the application of sophisticated capital budgeting practices (significant at the 1%-level). The specific uncertainties that manifest themselves through [B]RUS appear to be mostly "financial price/output uncertainty factors": they seem to affect the sales (or the receipts from these sales) of the organization. A comparison between β and [B]RUS indicates that these measures for uncertainty are related; however, β seems to reflect some specific uncertainties (output uncertainty, liability uncertainty) while [B]RUS encompasses the uncertainties relevant for capital budgeting practices.

In addition to uncertainty, the relationships between several other contingency factors (environment, technology, strategy, size and industry), uncertainty and capital budgeting practices have been investigated. These contingency factors have been derived from capital budgeting literature. It appears that (in addition to uncertainty) technology, investment strategy and size are related to capital budgeting practices. For other contingency factors, it has not been possible to test the previous relationship (environment, industry) or a relationship was not established (goals and objectives, corporate strategy, business unit strategy). Investment strategy and technology are factors that have not been identified as determinants of capital budgeting practices in previous research projects. The next figure provides the empirically derived "multiple contingency profile", as well as the relationships between the determinants of capital budgeting practices established in this research project and the factors identified in previous research projects.

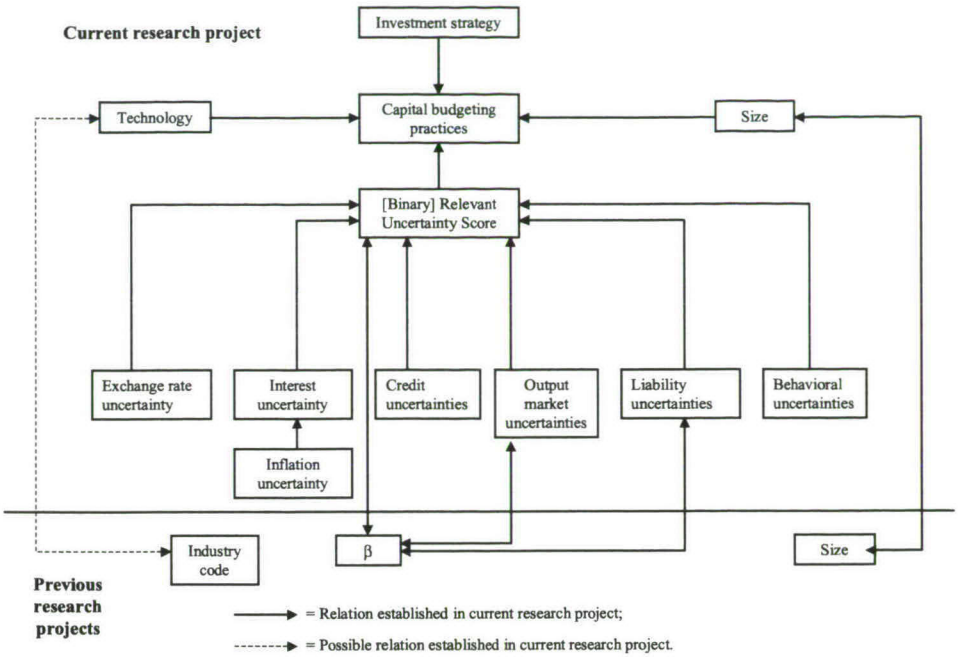

***Figure 7.3**: "Multiple contingency profile" for capital budgeting decision making*

The internal consistency of the previously presented "multiple contingency profile" has been investigated: it appears that [B]RUS, size, investment strategy and technology are separate determinants of capital budgeting practices. It is concluded that the comprehension of the relationships between uncertainty, other contingency factors and capital budgeting practices has been enhanced by the development of the "multiple contingency profile".

Capital budgeting practices and performance

The relationship between uncertainty, capital budgeting practices and performance has been investigated empirically in this study. Several performance measures have been used: two objective, financial performance measures (Return on Assets, ROA; and Return on Equity, ROE), their uncertainty-adjusted equivalents ($RTVR_{ROE}$ and $RTVR_{ROA}$; see section 4.3.4 for definitions), and one non-financial, subjective performance measure (effectiveness). Three methods have been used to investigate the hypothesized relationship. The interaction approach focuses on the explanation of variations in performance from the interaction between capital budgeting practices and uncertainty. The matched pair's approach compares the performance of

two fairly similar organizations (with regard to size, industry, investment strategy and uncertainty) that apply different capital budgeting practices. Finally, the systems approach analyzes whether there are "contingency paths" (interrelationships between uncertainty, other contingency factors and capital budgeting practices) that affect performance.

The findings from the analyses indicate that there appears to be no (significant) relationship between uncertainty, other contingency factors, capital budgeting practices and performance. Although disappointing, these findings are in accordance with most other research projects that have investigated the relationship between capital budgeting practices and performance. Some of the limitations which may have affected the analysis include the variance in profit (sum of variance in revenues and costs), the use of accounting data (vulnerability to accounting changes, use of proxies, variability in performance measures), the exclusion of other factors (financial structure, etc.) that may have an impact on capital budgeting practices, the use of net returns instead of gross returns and the exclusion of organizations that have gone bankrupt.

7.3 Recommendations for future research

There are a number of possibilities for future research that result from this research project. First of all, the rather qualitative and subjective measures of uncertainty used in this thesis (the Relevant Uncertainty Score, RUS; and the binary RUS, BRUS) may be "transcernable" into objective, quantitative measures of uncertainty. This research project has relied on subjective estimates for the impact of several uncertainties on the (projected) results of the organization. A comparison of [B]RUS with β indicates that the respondents appear to have captured the uncertainties that affect their organization fairly well. An objective measure of RUS may provide answers to organizations with regard to questions such as: when is exchange rate uncertainty too high for SRA-methods? When is the total level of uncertainty too high and do we change to other capital budgeting practices?

Also, the relationship between operational, financial and strategic risk management, the management accounting system and [B]RUS may be evaluated. Such an evaluation would offer the opportunity to determine how (buying insurance, buying or selling derivatives, avoidance of projects, change in application of specific capital budgeting practices), where (operational management, staff function, top management) and why (risk attitude of top management) specific uncertainties are managed most efficiently within the organization.

Another potential research issue regards the relationship between other contingency factors and capital budgeting practices. For example, the environment has been characterized by two factors: the degree of complexity (simple-complex) and the degree of stability (static-dynamic). Respondents have been asked to select the combination of factors that described their environment best; therefore, environment has also been measured on a single-item scale. Most respondents indicate that they operate in a complex, dynamic environment; as a result, the impact of the environment on capital budgeting practices is hardly measurable. Refining the environment in "complexity factors" (such as the number and impact of current competitors in the market, the complexity to market/develop new products, etc.) and "stability factors" (such as the entrance of new competitors, changes in demand for the organization's products, etc.) may reveal some additional information on the relationship between the environment and capital budgeting practices (see Waterhouse & Tiessen [1978]; Gordon & Miller [1976]). Another example includes the detected relationship between technology and capital budgeting practices. Technology has been measured as a single-item measure in this research project, mainly to limit the size of the questionnaire. Additional research on this subject may reveal whether the discovered relationship between (the turbulence of) technology and the sophistication of capital budgeting practices is confirmed in following research projects and, if that is the case, provide information on the (sub)factors that determine this relationship.

Finally, the relationship between organizational characteristics in general (such as ownership structure, financial structure, reward structure, etc.) and capital budgeting practices may be deepened and evaluated (see Chen [1995]; Haka [1987]; Larcker [1983]). This may result in the (potential) expansion of the current "multiple contingency profile" with some of the factors mentioned previously.

An in-depth analysis of the relationships between objectives, strategies and capital budgeting practices may also result in new insights. The current research project used fairly generic description of strategic issues; no significant relationship between the strategic issues and capital budgeting practices has been found. Additional research on goals and objectives, elements from corporate or business unit strategy and capital budgeting practices may result in a better understanding of linkages between these issues. For example, the impact of specific strategic elements (Slagmulder [1997]), familiarity of top management (Lillis [1992]) and the use of formalized planning & control systems (Simons [1987]) seem to present avenues for further research.

Additional research on the relationship between capital budgeting practices and performance (either financial, such as stock prices or ROI, or non-financial, such as effectiveness) is also necessary. The current research project has shown that the appli-

cation of advanced capital budgeting practices does not result in a better (net) accounting performance. It has not been possible to use stock price data in this research project due to the limited number of stock-listed organizations in the Netherlands. Replication of the study at European level may results in additional insights; however, country-specific legislation may disturb the results in that situation. In addition, it is questionable whether this gives rise to more conclusive findings (see Haka et al [1985]). The use of gross performance (i.e., excluding the costs of capital budgeting practices) instead of net results may also provide additional insights. Case studies are probably necessary to establish the relationship between the costs of simple and advanced capital budgeting practices and gross performance. The analysis of capital budgeting practices of bankrupt organizations and a comparison of these results with the results for capital budgeting practices of going concern organizations may reveal whether the application of sophisticated capital budgeting practices provides some "protection" against bankruptcy (Stulz [1996]). Also, the analysis of capital budgeting practices of organizations in turn-around situations may reveal whether the implementation of sophisticated capital budgeting practices is one of the means of coping with economic stress (Haka et al [1985]).

7.4 Summary and Conclusions

Concluding, this thesis has presented some results that have provided additional insight in the factors that affect the application of sophisticated capital budgeting practices. A theoretical framework has been developed to examine the relationships between uncertainty, other contingencies, capital budgeting practices and performance (see chapter 3). The theory contends that "low uncertainty organizations" are expected to use relatively simple capital budgeting practices, while "high uncertainty organizations" are expected to apply sophisticated capital budgeting practices.

The findings support the theory that there are relationships between uncertainty, other contingency factors and capital budgeting practices; however, an "appropriate match" between these variables does not necessarily result in a higher performance. The most important results from this study are:

1. *Similar trends as in other Western-European countries:* a comparison of the results from the current study with survey results from other Western-European countries suggests that the situation with regard to capital budgeting practices is similar. The trends recognized in this study (increases or at least stabilization of the importance of uncertainty analysis, fairly high "application percentages" for DCF-methods and combinations of capital budgeting decision rules) are also observed in other countries.
2. *Classification of organizations on most advanced criteria used:* 54% of the organizations is classified as using rather simple capital budgeting practices, while 46% is classified as advanced. The advanced capital budgeting group can be subdivided in organizations that rely mostly on DCF-methods for decision making, and organizations that also use game theory and option theory decision rules. The classification is based on the question whether organizations apply uncertainty analysis, -adjustment and -capital budgeting decision rules on a structural basis. The criteria result in a classification based on the *most advanced techniques* used rather than in mutually exclusive categories.
3. *Specific uncertainties are related to capital budgeting practices:* the results from this study indicate that an increase in uncertainty is associated with the application of more advanced capital budgeting practices. The "(binary) relevant uncertainty score", (B)RUS, specifies the uncertainties that affect capital budgeting practices. Finally, (B)RUS is more related to the application of advanced capital budgeting practices than β. The current research project has resulted in the recognition of ex ante *determinants* of capital budgeting practices rather than in an ex post general measure (or resultant) for uncertainty.
4. *Other contingency factors are related to advanced capital budgeting practices:* in addition to uncertainty, other contingency factors (size, technology and investment strat-

egy) are related to the application of sophisticated capital budgeting practices. Technology and investment strategy are contingency factors that have not been identified as determinants of capital budgeting practices in previous research projects.

5. *Development of "multiple contingency profile":* based upon the factors mentioned previously, a "multiple contingency profile" has been derived empirically. The factors identified as determinants of capital budgeting practices in previous research projects have been compared to this "multiple contingency profile".
6. *Capital budgeting practices and performance:* the application of advanced capital budgeting practices in specific situations does not seem to result in a higher performance. Although somewhat disappointing, these results are in accordance with most other research projects that have investigated the relationship between capital budgeting practices and performance. The main reason for the lack of a relation is probably the "variance effect" in profit (sum of variance in revenues and costs).

The findings presented here indicate that advanced capital budgeting practices seem to become particularly important when organizations have to deal with (many) uncertainties in the investment decision. Additional in-depth studies are necessary to verify and refine some of the established relationships presented in this thesis. This study has been started to provide a first step in understanding how organizations deal with uncertainty in the investment decision. Hopefully, this study will assist those who have to make the investment decision, as well as those who are studying, designing or implementing management control systems.

APPENDIX TO CHAPTER 4

METHODOLOGY AND DATA

Appendix 4.1 Survey

Naam bedrijf
T.a.v. Financieel Directeur
Adres
Postcode & Woonplaats

Gouda, 1 mei 1997

Geachte heer/mevrouw,

Bijgaand treft u een vragenlijst aan, die bedoeld is om gegevens te verzamelen voor een promotie-onderzoek van ondergetekende aan de Faculteit der Economische Wetenschappen van de Katholieke Universiteit Brabant in Tilburg. Het onderzoek wordt begeleid door Prof. Dr. R. Bannink van dezelfde universiteit.

Het onderzoek heeft tot doel om inzicht te verschaffen in de wijze waarop organisaties omgaan met onzekerheden en risico's in de investeringsselectie. Via de bijgevoegde enquête wordt getracht om de huidige praktijk op dit terrein inzichtelijk te maken. De enquête wordt daartoe naar directieleden en financiële medewerkers van circa 800 organisaties in Nederland verzonden. Het is de bedoeling dat u, als vertegenwoordiger van uw organisatieonderdeel (business unit, werkmaatschappij of divisie) de bijgevoegde vragenlijst invult. Uw medewerking is van groot belang, aangezien de hypothesen uit het theoretische deel van het onderzoek getoetst worden aan uw antwoorden. Ik zou het daarom zeer op prijs stellen indien u de vragenlijst zou willen invullen en in de bijgevoegde retourenveloppe zou willen terugzenden (zo mogelijk voor 20 juni a.s.).

Getracht is om de lengte van de enquête zo beperkt mogelijk te houden. Het invullen van de enquête bleek bij het testen ongeveer 30 minuten in beslag te nemen. Indien u de laatste pagina van de enquête invult, kan ik u de resultaten van de enquête toezenden. Het spreekt vanzelf dat de anonimiteit van uw organisatie wordt gegarandeerd; de verzamelde gegevens zijn vertrouwelijk en worden alleen in het kader van het onderzoek gebruikt.

Mocht u nog vragen hebben naar aanleiding van deze enquête, dan kunt u contact opnemen via het onderstaande adres. Ik dank u voor uw medewerking aan dit onderzoek.

Hoogachtend,

Drs. F.H.M. Verbeeten MBA
Groenhovenweg 409
2803 DK Gouda
Tel: 0182 - 533801 (p)

Bijlage(n):
Enquête Risicomanagement in investeringsbeslissingen

Handleiding enquete: "Risicomanagement in Investeringsbeslissingen"

Indeling van de enquête

De enquête bestaat uit zes delen:

1. Organisatiekenmerken
2. Risico's, onzekerheden en reacties
3. Risicomanagement binnen investeringsbeslissingen
4. Effectiviteit investeringsbeslissingen
5. Additionele opmerkingen
6. Begrippenlijst

Algemene richtlijnen

Ieder deel van de enquête wordt - zo nodig - voorafgegaan door een instructie. Daarnaast gelden de volgende algemene richtlijnen:

- Bij meerkeuzevragen is het de bedoeling dat slechts één antwoord wordt aangekruist. Kunt u moeilijk kiezen, kies dan voor ***die mogelijkheid die het beste bij u past***!
- Voor het uiteindelijk resultaat is het belangrijk dat ***alle*** vragen worden ingevuld. Mocht u niet tot een eenduidig antwoord kunnen komen, probeert u dan een redelijke schatting te geven.
- Beantwoord alle vragen voor uw eigen functie, dat wil zeggen voor het ***organisatie-onderdeel*** (bedrijf, business unit, werkmaatschappij, bedrijfsonderdeel, divisie) waar u als ***manager verantwoordelijk*** voor bent of dat u als ***financieel deskundige*** tot uw ***aandachtsgebied*** rekent.
- Een aantal termen in de enquête is voorzien van een noot (n). Deze noten corresponderen met de nummering in de bijgevoegde begrippenlijst, zodat u bij onduidelijkheid omtrent de begrippen deze lijst kunt raadplegen.
- Onder het begrip "***investering***" wordt in deze enquête verstaan: een besteding van het vermogen van een organisatie aan een door de organisatie beheerd bedrijfsmiddel, waaruit in de toekomst naar verwachting gedurende langere termijn (meer dan een jaar) economische voordelen naar de organisatie zullen vloeien.
- Afhankelijk van de aard van uw organisatie-onderdeel kan een investering zowel betrekking hebben op materiële activa (huisvesting, machines, kapitaalgoederen, fusie/overname, computersystemen), immateriële activa (R&D/productontwikkeling, goodwill, eigendomsrechten) en financiële activa (beleggingen voor een langere termijn).
- Beantwoord de vragen zoveel mogelijk voor het totale investeringsprogramma zoals dat door uw organisatie-onderdeel in de afgelopen 2 tot 3 jaar is geïmplementeerd (d.w.z. niet voor een specifieke grote of kleine investering, maar voor het gehele programma).
- Houdt u bij het beantwoorden van de vragen over risico's en onzekerheden rekening met een tijdsraam dat gebruikelijk is bij het beoordelen van investeringen in activa (als richtlijn: ongeveer vijf jaar).
- Het terugsturen van de enquête volstaat; de brief, de handleiding en de begrippenlijst kunnen worden behouden.
- Let op: de enquête is ***dubbelzijdig*** gedrukt.

1. Organisatiekenmerken

Toelichting

In dit deel van de enquête wordt een aantal voor het onderzoek relevante kenmerken van u en uw organisatie-onderdeel geïnventariseerd. Gevraagd wordt om zoveel mogelijk het meest passende alternatief aan te kruisen, dan wel de gevraagde gegevens in te vullen. Indien in een enkele situatie de vooraf gegeven antwoorden de situatie binnen uw organisatie-onderdeel niet adequaat beschrijven, kunt u veelal zelf een alternatief aangeven. In dat geval wordt u tevens om een korte toelichting gevraagd.

1.1 Gegevens functionaris

Gevraagd wordt naar de functie en het aantal jaren ervaring van degene die de vragen beantwoord.

1. Wat is de omschrijving van uw functie binnen uw organisatie-onderdeel?
   - ◊ Algemeen management/directeur 3,7%
   - ◊ Financieel directeur 39,2%
   - ◊ Controller 42,3%
   - ◊ Treasurer 2,6%
   - ◊ Financieel economisch medewerker/business analist 5,3%
   - ◊ Anders 6,8%

2. Hoe lang bent u al werkzaam in bovenstaande functie bij uw organisatie-onderdeel?
   - ◊ 1 tot 3 jaar 36,7%
   - ◊ 3 tot 6 jaar 30,9%
   - ◊ meer dan 6 jaar 32,4%

1.2 Gegevens organisatie-onderdeel

In deze vraag wordt ingegaan op een aantal kenmerken van uw organisatie-onderdeel. U wordt verzocht het meest passende alternatief aan te kruisen, respectievelijk de gevraagde gegevens in te vullen voor uw organisatie-onderdeel.

3. In welke tak van industrie is uw organisatie-onderdeel werkzaam (*zie Begrippenlijst pagina 1; de bedrijfstakcodes stemmen overeen met de codes van het CBS*)?

Bedrijfstak-code	***Omschrijving***	***Percentage in steekproef***
A	Landbouw, jacht en bosbouw	0,5%
B	Visserij, kweken van vis en schaaldieren	0,0%
C	Delfstoffenwinning	1,0%
D	Industrie	36,3%
E	Openbare voorzieningsbedrijven	7,5%
F	Bouwbedrijven	4,3%
G	Reparatie consumentenartikelen; handel	10,2%
H	Horeca	0,0%
I	Vervoer, opslag en communicatie	6,4%
J	Financiële instellingen	13,4%
K	Verhuur en zakelijke dienstverlening	8,5%
L	Overheid/non-profit/overige dienstverlening	6,4%

4. Wat was de omvang van het totaal vermogen van uw organisatie-onderdeel aan het einde van het boekjaar 1996 (in casu, het balanstotaal)?
   - ◊ tot *f* 100 miljoen 21,8%
   - ◊ van *f* 100 miljoen tot *f* 500 miljoen 40,8%
   - ◊ van *f* 500 miljoen tot *f* 1 miljard 12,8%
   - ◊ meer dan *f* 1 miljard 24,6%

5. Wat was de omvang van het werknemersbestand van uw organisatie-onderdeel (in fte's) aan het einde van het boekjaar 1996?
   - ◊ tot 500 fte 26,6%
   - ◊ van 500 fte tot 1000 fte 28,7%
   - ◊ van 1000 fte tot 5000 fte 32,5%
   - ◊ meer dan 5000 fte 12,2%

6. Hoe groot was de omzet van uw organisatie-onderdeel in het boekjaar 1996?
   - ◊ tot *f* 100 miljoen 11,3%
   - ◊ van *f* 100 miljoen tot *f* 500 miljoen 42,9%
   - ◊ van *f* 500 miljoen tot *f* 1 miljard 17,0%
   - ◊ meer dan *f* 1 miljard 28,8%

7. Wat is de leeftijd van uw organisatie-onderdeel?
   - ◊ tot 20 jaar 25,7%
   - ◊ van 20 tot 50 jaar 30,6%
   - ◊ van 50 tot 100 jaar 26,2%
   - ◊ meer dan 100 jaar 17,5%

1.3 Omgevingsfactoren

In de volgende paragraaf wordt een aantal kenmerken van uw organisatie-onderdeel geïnventariseerd. Uw wordt verzocht om het meest passende alternatief aan te geven.

8. De omgeving van uw organisatie-onderdeel kan worden gekenmerkt als:
   - ◊ eenvoudig en stabiel 6,9%
   - ◊ eenvoudig en dynamisch 23,4%
   - ◊ complex en stabiel 9,6%
   - ◊ complex en dynamisch 60,1%

9. De technologie[1] binnen uw organisatie-onderdeel in verhouding tot de bedrijfstak waarin u opereert in het algemeen is te kenmerken als *(zie Begrippenlijst pagina 4)*:
   - ◊ geavanceerd [1] 20,6%
   - ◊ innovatief [1] 30,7%
   - ◊ (vrijwel) identiek voor alle organisaties binnen de bedrijfstak [1] 47,1%
   - ◊ anders 1,6%

10. De structuur van uw organisatie-onderdeel kan gekenmerkt worden als een *(zie Begrippenlijst pagina 4)*:
    - ◊ (onderdeel van) een sterk samenhangend geheel 47,1%
    - ◊ (onderdeel van) een beperkt gediversificeerde organisatie 31,2%
    - ◊ (onderdeel van) een sterk gediversificeerde organisatie 21,2%
    - ◊ anders 0,5%

11. De strategie van uw organisatie-onderdeel kan voornamelijk worden gekenmerkt als:
    - ◊ een "build"-strategie, waarbij het vergroten van marktaandeel belangrijker is dan de korte termijn winst en de kasstroom van het organisatie-onderdeel 49,7%
    - ◊ een "hold"-strategie, waarbij het beschermen van het marktaandeel en de concurrentiepositie van het organisatie-onderdeel centraal staat 40,1%
    - ◊ een "harvest"-strategie, waarbij de maximalisatie van de korte termijn winst en kasstroom belangrijker is dan het marktaandeel van het organisatie-onderdeel 5,3%
    - ◊ een "divest"-strategie, waarbij het organisatie-onderdeel zich terugtrekt uit de betreffende activiteit -
    - ◊ een mix van bovenstaande strategieën 4,8%

2. Risico's, onzekerheden en reacties

Toelichting

Het tweede gedeelte heeft betrekking op de risico's en onzekerheden die van invloed (kunnen) zijn op het opereren van uw organisatie-onderdeel. Het draait om een tweetal aspecten:

- de risico's en onzekerheden waar uw organisatie-onderdeel mee te maken heeft;
- de reacties van uw organisatie-onderdeel op die risico's en onzekerheden.

In de volgende vragen wordt ingegaan op de *risico's, onzekerheden en reacties* daarop, welke voor uw organisatie-onderdeel ***binnen het tijdsraam van de investeringsbeslissing*** een rol spelen. Bij de beantwoording van de vragen dient dan ook uitgegaan te worden van een tijdsraam waarbinnen investeringen beoordeeld worden. Als uitgangspunt kan een termijn van ***ongeveer 5 jaar*** gehanteerd worden, waarbinnen de volgende risico's en onzekerheden zich *kunnen* materialiseren.

Per onderdeel wordt gevraagd om in een vijfpuntsschaal aan te geven in welke mate de verschillende risico's en onzekerheden van invloed zijn op het opereren van uw organisatie-onderdeel, respectievelijk in welke mate uw organisatie-onderdeel gebruik maakt van een aantal risicobeperkende maatregelen.

2.1. Risico's en onzekerheden organisatie-onderdeel

12. Hoe belangrijk is de invloed van de nu volgende ***algemene*** risico's en onzekerheden op de beoogde resultaten van uw organisatie-onderdeel (*zie Begrippenlijst pagina 5*)?
(1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Politieke onzekerheden[3] (veranderingen in politiek regime)	18,4%	29,6%	20,5%	22,7%	8,6%
Beleidsmatige onzekerheden[4] (veranderingen in beleid van diverse overheidsorganen, zoals regeringen en/of gemeenten)	1,6%	13,9%	21,9%	41,2%	21,4%
Macro-economische onzekerheden[5], zoals:					
Valuta-onzekerheden	12,2%	22,9%	21,8%	32,4%	10,6%
Rente-onzekerheden	4,8%	20,7%	33,0%	30,9%	10,6%
Inflatie-onzekerheden	3,2%	21,3%	36,7%	31,9%	6,9%
Andere macro-economische onzekerheden, zoals (svp toelichten):.....					
Maatschappelijke onzekerheden[6] (maatschappelijke weerstand)	14,4%	29,3%	28,2%	25,5%	2,7%
Natuurlijke onzekerheden[7] (natuurrampen)	23,9%	30,9%	26,6%	13,3%	5,3%
Andere algemene onzekerheden, zoals (svp toelichten):					

13. Hoe belangrijk is de invloed van de nu volgende ***bedrijfstakspecifieke*** risico's en onzekerheden op de beoogde resultaten van uw organisatie-onderdeel (*zie Begrippenlijst pagina 5*)?

(1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Onzekerheden omtrent input-markt[8] (sterke wisselingen in kwaliteit en/of kwantiteit inputs, zoals grondstoffen en personeel)	2,6%	22,2%	28,6%	32,3%	14,3%
Onzekerheden omtrent de afzetmarkt[9] (sterke wisselingen in de vraag naar producten in zijn algemeenheid op bedrijfstakniveau)	0,5%	11,1%	18,5%	47,1%	22,8%
Onzekerheden omtrent concurrenten[10] (intensiverende concurrentieverhoudingen, lage toetredingsbarrieres)	1,6%	4,2%	22,8%	56,1%	15,3%
Andere bedrijfstakspecifieke onzekerheden, zoals (svp toelichten):					

14. Hoe belangrijk is de invloed van de nu volgende ***organisatiespecifieke*** risico's en onzekerheden op de beoogde resultaten van uw organisatie-onderdeel (*zie Begrippenlijst pagina 6*)?

(1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Operationele onzekerheden[11], zoals:					
Arbeidsonzekerheden (wisselingen in arbeidsproductiviteit, stakingen)	5,8%	34,9%	23,8%	28,6%	6,9%
Grondstoffen (wisselingen in kwaliteit en kwantiteit)	22,2%	25,9%	21,7%	18,5%	11,6%
Productie-onzekerheden (wisselingen in output a.g.v. productiestoringen)	12,2%	20,7%	24,5%	28,2%	14,4%
Aansprakelijkheidsonzekerheden[12] (milieu-/productaansprakelijkheid)	6,3%	22,2%	31,2%	31,2%	9,0%
R&D onzekerheden[13] (wisselingen in resultaten onderzoeksprojecten)	13,8%	25,4%	29,6%	25,4%	5,8%
Kredietonzekerheden[14] (betalingsgedrag van klanten)	4,8%	30,9%	28,2%	29,3%	6,9%
Gedragsonzekerheden[15] (nastreven persoonlijk belang i.p.v. bedrijfsbelang, fraude)	9,5%	32,3%	34,4%	22,2%	1,6%
Andere organisatiespecifieke onzekerheden, zoals (svp toelichten):					

2.2 Reactie op risico's en onzekerheden

Er is een aantal maatregelen dat een organisatie-onderdeel kan nemen om de risico's en onzekerheden voor de bedrijfsvoering of de beoogde resultaten te beperken, respectievelijk af te dekken. Ook hier dient bij de beantwoording van de vragen rekening te worden gehouden met de beoordelingstermijn welke voor investeringsbeslissingen gehanteerd wordt (circa 5 jaar).

15. Hoe belangrijk is het gebruik van de nu volgende risicobeperkende of -dekkende maatregelen voor uw organisatie-onderdeel?

    (1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Afsluiten van verzekeringen	2,7%	8,1%	23,1%	48,4%	17,7%
Gebruik van financiële instrumenten (opties, FRA's, termijncontracten, etc)	16,0%	17,6%	24,6%	29,9%	11,8%
Verlagen van de verhouding vreemd vermogen/totaal vermogen	12,4%	15,6%	33,9%	32,8%	5,4%
Terugtrekken uit of uitbesteden van bepaalde activiteiten	7,5%	18,8%	28,0%	38,7%	7,0%
Spreiden van activiteiten (geografisch of in verschillende bedrijfstakken)	8,6%	15,0%	20,9%	44,9%	10,7%
Ondernemen van politieke of lobby-activiteiten	11,2%	19,3%	27,8%	32,1%	9,6%
Samenwerken met andere organisaties (joint ventures, strategische allianties)	3,2%	9,6%	20,3%	53,5%	13,4%
Beperken van risico's in bedrijfsvoering (inhuur uitzendkrachten, JIT-productie)	3,7%	8,6%	34,2%	44,4%	9,1%
Andere risicobeperkende of -dekkende maatregelen, zoals (svp toelichten):					

3. Risicomanagement binnen investeringsbeslissingen

Toelichting

In dit deel van de vragenlijst wordt ingegaan op de wijze waarop binnen uw organisatie-onderdeel investeringsbeslissingen worden genomen. Daarbij wordt aandacht besteed aan de volgende items:

- investeringsbeslissingen;
- analyse potentiële investeringsprojecten;
- investeringsstrategieën.

Ieder deel wordt voorafgegaan door een korte instructie.

3.1 Investeringsbeslissingen

Per onderdeel wordt voor de verschillende onderwerpen gevraagd om in een vijfpuntsschaal (variërend van 1= nooit tot 5= altijd) aan te kruisen in hoeverre binnen uw organisatie-onderdeel gebruik wordt gemaakt van de betreffende beslissingsmethode.

16. In welke mate maakt uw organisatie-onderdeel gebruik van de nu volgende beslissingsregels bij de selectie van investeringsprojecten (*zie Begrippenlijst pagina 7*)?

    (1= nooit, 2= zelden, 3= soms, 4 = meestal, 5= altijd)

	1	2	3	4	5
Terugverdientijd[16] (payback period)	5,8%	7,4%	18,0%	37,0%	31,7%
Boekhoudkundig rendement[17] (accounting rate of return)	27,0%	21,2%	19,0%	19,0%	13,8%
Winstgevendheidsindex[18] (profitability index)	35,1%	19,1%	22,3%	13,8%	9,6%
Interne rentevoet[19] (internal rate of return)	19,0%	14,3%	20,6%	23,8%	22,2%
Netto contante waarde[20] (discounted cash flow)	6,9%	6,9%	22,2%	31,7%	32,3%
Reële optiewaardering[21] (real option pricing)	59,9%	20,3%	14,4%	3,7%	1,6%
Speltheoretische beslissingsregels[22] (game theory decision rules)	70,7%	17,6%	6,4%	3,2%	2,1%
Niet-financiële beslissingsregels[23], zoals marktaandeel, omvang personeel, etc. (s.v.p. toelichten):					
Anders, namelijk (s.v.p. toelichten):					

17. In welke mate maakt uw organisatie-onderdeel gebruik van de volgende methoden om risico en onzekerheid binnen een investeringsproject tot uitdrukking te brengen (*zie Begrippenlijst pagina 8*)?

(1= nooit, 2= zelden, 3= soms, 4 = meestal, 5= altijd)

	1	2	3	4	5
Aanpassen van de terugverdienperiode	26,7%	19,3%	32,1%	16,6%	5,3%
Aanpassen van de rendementseis	20,9%	16,0%	34,8%	20,3%	8,0%
De mogelijke kosten van risicoreductie (verzekeringen, schadebeperkende maatregelen) ten laste brengen van de kasstromen	30,5%	19,3%	33,2%	12,8%	4,3%
Toewijzen van kansen aan scenario's en gebruik van gewogen kasstromen uit deze scenario's	42,0%	19,7%	23,9%	11,7%	2,7%
Gebruik van zekerheidsequivalenten[24] i.p.v. verwachte kasstromen	62,8%	20,7%	10,6%	3,7%	2,1%
Anders, namelijk (s.v.p. toelichten):					

3.2 Analyse potentiële investeringsprojecten

In dit deel van de vragenlijst wordt ingegaan op het traject van de risico-analyse binnen investeringsprojecten in uw organisatie-onderdeel.

18. Wat is voor uw organisatie-onderdeel het belang van de nu volgende methoden om de (financiële) consequenties van een potentieel investeringsproject te bepalen?
(1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Gevoeligheids-/break-even analyses (wat is de invloed van een wijziging in bepaalde veronderstellingen op het projectresultaat)	3,7%	8,0%	16,0%	56,9%	15,4%
Scenario-analyses (analyse van bepaalde combinatie van veronderstellingen)	5,9%	10,6%	19,7%	51,1%	12,8%
Monte Carlo simulaties (toekennen van kansverdeling aan bepaalde variabelen)	60,6%	22,3%	12,2%	4,3%	0,5%
Beslissingsbomen (toekennen van kansen aan alternatieve paden in het verloop van het project)	42,2%	28,9%	17,1%	10,7%	1,1%
CAPM-/ ß-analyse (analyseren van risico's in vergelijkbare projecten en vaststellen vermogenskostenvoet obv deze vergelijking)	49,5%	20,4%	14,5%	11,8%	3,8%
Anders, namelijk (s.v.p. toelichten):.....					

19. Wat is het belang van de nu volgende methoden voor het identificeren van risico's en onzekerheden in potentiële investeringsprojecten voor uw organisatie-onderdeel?

(1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Gebruik van checklists met potentiële verliesbronnen per soort project	21,5%	27,4%	26,3%	19,9%	4,8%
Analyse van (verwachte) projectbalans en/of – resultaten(rekening)	6,0%	7,6%	12,0%	57,1%	17,4%
Gebruik van stroomdiagrammen om risico's in de procesgang in kaart te brengen	25,4%	33,0%	18,9%	19,5%	3,2%
Inspecties ter plaatse bij vergelijkbare projecten	14,6%	17,8%	32,4%	29,7%	5,4%
Overleg met andere organisatie-eenheden (ingenieurs, marketing, productie)	7,6%	7,6%	18,4%	53,5%	13,0%
Overleg met externen (accountants, consultants, bankiers, juristen)	7,0%	12,9%	22,6%	46,8%	10,8%
Analyse van contracten die aan het investeringsproject zijn verbonden	5,9%	5,4%	15,1%	54,3%	19,4%
Analyse van statistische gegevensbestanden	14,1%	27,0%	27,6%	25,9%	5,4%
Analyse van omgevingsontwikkelingen	6,5%	11,4%	26,6%	45,7%	9,8%
Anders, namelijk (s.v.p. toelichten):					

3.3 Investeringsstrategieën

Organisatie-onderdelen kunnen via verschillende investeringsstrategieën trachten om hun doelstellingen te realiseren.

20. Welke beschrijving geeft het beste de door uw organisatie-onderdeel gevolgde investeringsstrategie weer (*slechts het meest passende alternatief aankruisen*)?

◊ Investeren in een brede range projecten die als totaal onder alle omstandigheden winst opleveren, zo vroeg mogelijk investeren (inzetten op een spreiding van investeringen, 'brede greenfieldstrategie') 19,2%

◊ Investeren in één of een klein aantal projecten die verbonden zijn aan een bepaalde strategie, zo vroeg mogelijk investeren (inzetten op één onzekere uitkomst, 'beperkte greenfieldstrategie') 26,7%

◊ Investeren in een beperkt aantal projecten, pas investeren wanneer het absoluut noodzakelijk is om een bepaalde strategie nog uit te kunnen voeren of wanneer belangrijke onzekerheden zijn opgelost ('beperkt overnamebeleid') 28,5%

◊ Investeren in een brede range projecten, pas investeren wanneer bepaalde onzekerheden zijn opgelost en aanpassen van strategie aan de mogelijkheden die zich voordoen (inzetten op diverse bijna zekere uitkomsten, 'breed overnamebeleid') 25,6%

4. Effectiviteit investeringsbeslissingen

Toelichting

In dit deel van de vragenlijst wordt gevraagd in welke mate de investeringsbeslissingen bijdragen aan het bereiken van de doelstellingen van uw organisatie. Dit gebeurt via twee invalshoeken. Eerst wordt gevraagd in welke mate de direct belanghebbenden (eigenaars, aandeelhouders, Raad van Commissarissen, Raad van Bestuur, andere superieuren) belang hechten aan het succes van uw organisatie op bepaalde gebieden. Vervolgens wordt gevraagd in hoeverre de doelstellingen op de genoemde gebieden daadwerkelijk gerealiseerd worden.

4.1 Oordeel direct belanghebbenden

21. In welke mate hechten, naar uw mening, de direct belanghebbenden (eigenaars, aandeelhouders, RvC, RvB, andere superieuren) in uw organisatie aan de performance van uw organisatie-onderdeel op de volgende gebieden?

    (1= totaal onbelangrijk, 2= vrij onbelangrijk, 3= neutraal, 4 = belangrijk, 5= zeer belangrijk)

	1	2	3	4	5
Winst, winstmarge	0,5%	1,1%	5,4%	35,9%	57,1%
Operationele kasstromen	1,6%	10,4%	18,0%	43,7%	26,2%
Beurswaarde, aandelenkoers, dividenduitkering	24,0%	11,2%	14,0%	26,3%	24,6%
Kostenbeheersing/-reductie	0,0%	1,6%	13,6%	53,3%	31,5%
Omzetgroei	2,2%	3,8%	23,9%	44,6%	25,5%
Marktaandeel	2,2%	3,3%	31,5%	38,6%	24,5%
Ontwikkeling van nieuwe markten en producten	1,1%	7,7%	25,7%	51,4%	14,2%
Onderzoek en ontwikkeling/R&D	6,0%	14,7%	38,0%	32,1%	9,2%
Kwaliteit, dienstbaarheid klanten	0,0%	3,2%	9,2%	44,9%	42,7%
Personeelsontwikkeling/ontwikkeling van "human capital"	1,6%	7,6%	28,1%	45,4%	17,3%
Politieke en maatschappelijke effecten	3,3%	23,9%	41,3%	23,9%	7,6%
Ethische integriteit van het organisatie-onderdeel	4,4%	8,7%	35,5%	39,3%	12,0%

4.2 Prestaties organisatie-onderdeel

22. In hoeverre presteert uw organisatie-onderdeel, vanuit uw eigen perspectief, op voorgaande gebieden naar tevredenheid?

(1= zeer ontevreden, 2= ontevreden, 3= soms tevreden, 4= tevreden, 5= zeer tevreden)

	1	2	3	4	5
Winst, winstmarge	0,5%	13,2%	25,8%	52,2%	8,2%
Operationele kasstromen	0,0%	10,4%	31,3%	51,1%	7,1%
Beurswaarde, aandelenkoers, dividenduitkering	4,3%	14,9%	31,1%	40,4%	9,3%
Kostenbeheersing/-reductie	2,2%	16,3%	39,1%	39,7%	2,7%
Omzetgroei	0,6%	10,5%	47,0%	35,4%	6,6%
Marktaandeel	1,1%	10,6%	46,1%	37,8%	4,4%
Ontwikkeling van nieuwe markten en producten	1,1%	15,6%	49,4%	31,7%	2,2%
Onderzoek en ontwikkeling/R&D	2,2%	15,6%	52,8%	27,8%	1,7%
Kwaliteit, dienstbaarheid klanten	0,5%	7,1%	42,9%	42,9%	6,5%
Personeelsontwikkeling/ontwikkeling van "human capital"	1,6%	13,0%	45,7%	37,5%	2,2%
Politieke en maatschappelijke effecten	1,7%	8,3%	56,7%	31,7%	1,7%
Ethische integriteit van het organisatie-onderdeel	0,6%	4,4%	33,3%	55,6%	6,1%

5. Additionele opmerkingen

Indien u naar aanleiding van deze enquête nog vragen of opmerkingen heeft, kunt u die hieronder vermelden.

Additionele gegevens
Indien u in aanmerking wenst te komen voor toezending van enquêteresultaten, dan kunt u hier uw adres invullen:

Organisatie: .....
T.a.v.: .....
Adres: .....
Plaats: .....

Het kan zijn dat in het belang van het onderzoek additionele informatie omtrent uw bedrijf nodig is, in de vorm van jaarrekeningen over de afgelopen vijf jaar. Kan ik in dat geval contact met u opnemen voor aanvullende (financiële) informatie?

◊ Ja
◊ Nee, omdat .....

Voor terugzending van de ingevulde enquête kunt u gebruik maken van bijgevoegde antwoordenveloppe. De enveloppe is geadresseerd aan:

Katholieke Universiteit Brabant
Sectie KWW, kamer B 718
Antwoordnummer 60669
5000 BW Tilburg

Begrippenlijst

A. Bedrijfstakcodes CBS

In de volgende tabel zijn de bedrijfstakcodes van het CBS vermeld. U wordt verzocht om de gegevens die betrekking hebben op uw organisatie(onderdeel) uit kolom 2 ("Bedrijfstakcode") en kolom 3 ("Omschrijving") over te nemen op het enquêteformulier.

Sectie	Bedrijfstak-code	Omschrijving
A		**Landbouw, jacht en bosbouw**
	01	Landbouw, jacht en dienstverlening t.b.v. landbouw en jacht
	02	Bouwbouw en dienstverlening t.b.v. bosbouw
B		**Visserij**
	05	Visserij, kweken van vis en schaaldieren
C		**Winning van delfstoffen**
	10	Turfwinning
	11	Aardolie- en aardgaswinning en dienstverlening t.b.v. aardolie- en aardgaswinning
	14	Winning van zand, grind, klei, zout, etc
D		**Industrie**
	15	Vervaardiging van voedingsmiddelen en dranken
	16	Verwerking van tabak
	17	Vervaardiging van textiel
	18	Vervaardiging van kleding; bereiden en verven van bont
	19	Vervaardiging van leer en lederwaren (excl. kleding)
	20	Houtindustrie en vervaardiging van artikelen van hout, kurk, riet en vlechtwerk (excl. meubels)
	21	Vervaardiging van papier, karton en papier- en kartonwaren
	22	Uitgeverijen, drukkerijen en reproduktie van opgenomen media
	23	Aardolie- en steenkoolverwerkende industrie; bewerking van splijt- en kweekstoffen
	24	Vervaardiging van chemische produkten
	25	Vervaardiging van produkten van rubber en kunststof
	26	Vervaardiging van glas, aardewerk, cement-, kalk- en gipsproducten
	27	Vervaardiging van metalen in primaire vorm
	28	Vervaardiging van produkten van metaal (excl. machines en transportmiddelen)
	29	Vervaardiging van machines en apparaten
	30	Vervaardiging van kantoormachines en computers
	31	Vervaardiging van overige elektrische machines, apparaten en benodigdheden
	32	Vervaardiging van audio-, video- en telecommunicatie-apparatuur en benodigdheden
	33	Vervaardiging van medisch apparaten en instrumenten, orthopedische artikelen e.d. precisie- en optische instrumenten en uurwerken

Sectie	Bedrijfstak-code	Omschrijving
	34	Vervaardiging van auto's, aanhangwagens en opleggers
	35	Vervaardiging van transportmiddelen (excl. auto's, aanhangwagens en opleggers)
	36	Vervaardiging van meubels; vervaardiging van overige goederen n.e.g.
	37	Voorbereiding tot recycling
E		**Produktie en distributie van elektriciteit, aardgas en warm water**
	40	Produktie en distributie van elektriciteit, aardgas, stroom en warm water
	41	Winning en distributie van water
F		**Bouwnijverheid**
	45	Bouwnijverheid
G		**Reparatie van consumentenartikelen en handel**
	50	Handel en reparatie van auto's en motorfietsen; benzineservicestations
	51	Groothandel en handelsbemiddeling (niet in auto's en motorfietsen)
	52	Detailhandel en reparatie t.b.v. particulieren (excl. auto's, motorfietsen en motorbrandstoffen)
H		**Horeca**
	55	Logies-, maaltijden- en drankverstrekking
I		**Vervoer, opslag en communicatie**
	60	Vervoer over land
	61	Vervoer over water
	62	Vervoer door de lucht
	63	Dienstverlening t.b.v. het vervoer
	64	Post en telecommunicatie
J		**Financiële instellingen**
	65	Financiële instellingen (excl. verzekeringswezen en pensioenfondsen)
	66	Verzekeringswezen en pensioenfondsen (excl. verplichte sociale verzekeringen)
	67	Activiteiten t.b.v. of verwant aan financiële instellingen
K		**Verhuur van en handel in onroerend goed, verhuur van roerende goederen en zakelijke dienstverlening**
	70	Verhuur van en handel in onroerend goed
	71	Verhuur van transportmiddelen, machines en werktuigen zonder bedienend personeel en van overige roerende goederen
	72	Computerservice- en informatietechnologiebureaus e.d.
	73	Speur- en ontwikkelingswerk
	74	Overige zakelijke dienstverlening
L		**Openbaar bestuur, overheidsdiensten en verplichte sociale verzekeringen**
	75	Openbaar bestuur, overheidsdiensten en verplichte sociale verzekeringen
M		**Onderwijs**
	80	Onderwijs
N		**Gezondheids- en welzijnszorg**
	85	Gezondheids- en welzijnszorg
O		**Milieudienstverlening, cultuur, recreatie en overige dienstverlening**

Sectie	Bedrijfstak-code	Omschrijving
	90	Milieudienstverlening
	91	Werkgevers-, werknemers- en beroepsorganisaties; levensbeschouwelijke en politieke organisaties; overige ideële organisaties e.d.
	92	Cultuur, sport en recreatie
	93	Overige dienstverlening
P		**Particuliere huishoudens met personeel in loondienst**
	95	Particuliere huishoudens met personeel in loondienst
Q		**Extra-territoriale lichamen en organisaties**
	99	Extra-territoriale lichamen en organisaties

B. Verklaring van begrippen uit de enquête

Bij vraag 9 van de enquête:

1. Technologie

De term 'technologie' heeft betrekking op de methoden en processen van uw organisatie-onderdeel om input te transformeren tot output. De technologie verwijst dus naar de kennisbasis van het organisatie-onderdeel, waarmee goederen worden voortgebracht. De technologie kan op drie manieren worden gekarakteriseerd:

- geavanceerd: de technologie biedt een organisatie-onderdeel de kans zich te onderscheiden ten opzichte van de rest van de organisaties in de bedrijfstak, maar de wijze waarop goederen worden voortgebracht is nauwelijks aan ontwikkelingen onderhevig;
- innovatief: niet alleen kan onderscheid gemaakt worden naar de produktiemethoden/-processen binnen verschillende organisaties in de bedrijfstak, maar deze produktiemethoden/-processen zijn ook sterk in ontwikkeling;
- identiek voor alle organisaties binnen een bedrijfstak: alle organisaties hanteren min of meer dezelfde produktiemethoden/-processen.

Bij vraag 10 van de enquête:

2. Structuur

De term 'structuur' heeft betrekking op de wijze waarop taken en verantwoordelijkheden zijn toegewezen binnen de organisatie en de wijze waarop de uit te voeren activiteiten worden gecoördineerd. De structuur van een organisatie kan op drie manier getypeerd worden:

- een sterk samenhangend geheel: een organisatie-onderdeel kan getypeerd worden als (een deel van) een 'sterk samenhangend geheel' van activiteiten wanneer de organisatie als geheel slechts actief is in één specifieke bedrijfstak (single business). Dergelijke organisaties zijn meestal functioneel georganiseerd, waarbij het top management zowel verantwoordelijk is voor de 'overall strategie' van de organisatie als voor een functionele strategie op een bepaald gebied (marketing, produktie, financiering);

- een beperkt gediversificeerde organisatie: een organisatie-onderdeel kan getypeerd worden als (een deel van) een beperkt gediversificeerde organisatie wanneer de organisatie als geheel slechts actief is in een beperkt aantal bedrijfstakken (related diversified). Deze bedrijfstakken zijn verbonden met elkaar via dezelfde klanten, dezelfde distributiekanalen, dezelfde technologie of een andere verbindende factor. De belangrijkste karakteristiek van dergelijke organisaties is dat zij beschikken over bepaalde kerncompetenties waar meerdere organisatie-onderdelen van kunnen profiteren;
- een sterk doorgevoerde diversificatie (conglomeraat): een organisatie-onderdeel kan getypeerd worden als een deel van een conglomeraat wanneer de organisatie als geheel georganiseerd is in relatief autonome business units. De verschillende organisatie-onderdelen zijn actief in diverse, soms totaal verschillende bedrijfstakken. Ieder organisatie-onderdeel wordt geleid door een management-team, dat in principe een vrij grote zeggenschap heeft over de te benaderen markten en de te voeren produkten, zolang maar aan de financiële vereisten van de holding wordt voldaan.

Bij vraag 12 van de enquête:

3. Politieke risico's en onzekerheden
Politieke risico's en onzekerheden verwijzen naar de risico's en bedreigingen die zijn gekoppeld aan belangrijke veranderingen in politieke regimes, regeringen en het politieke systeem. Politieke instabiliteit kan voortkomen uit oorlog, revolutie en andere politieke rellen en kan van invloed zijn op het opereren van het organisatie-onderdeel in de betreffende regio van de wereld.

4. Beleidsmatige onzekerheden
Beleidsmatige onzekerheden verwijzen naar veranderingen in het overheidsbeleid, welke hun invloed kunnen hebben op het opereren van organisatie-onderdelen. De belangrijkste beleidsmatige onzekerheden komen voort uit onverwachte fiscale en monetaire hervormingen, wetswijzigingen en het vaststellen van maximumprijzen.

5. Macro-economische onzekerheden
Macro-economische onzekerheden verwijzen naar wijzigingen in het consumptiepatroon en het prijspeil. Wijzigingen in het prijspeil kunnen zowel hun beslag hebben in algemene inflatie, als in specifieke vorm (prijzen van "commodities", wisselkoersveranderingen, rentewijzigingen).

6. Maatschappelijke onzekerheden
Maatschappelijke onzekerheden ontstaan als gevolg van (onverwachte) veranderingen in het geloof, de waarden en de houding van een groot deel van de bevolking, welke nog niet zijn doorgedrongen tot het overheidsbeleid of het bedrijfsleven. Maatschappelijke onzekerheden komen vaak boven in maatschappelijke protesten, sociale onrust, rellen, demonstraties en zelfs kleinschalige terroristische acties.

7. Natuurlijke onzekerheden

Natuurlijke onzekerheden worden veroorzaakt door natuurlijke omstandigheden die economisch gevolgen hebben. Daarbij kan gedacht worden aan orkanen, aardbevingen, overstromingen, fluctuaties in regenval, etc. Het vestigen van het organisatie-onderdeel in een bepaalde regio kan aanzienlijke natuurlijke onzekerheden tot gevolg hebben.

Bij vraag 13 van de enquête:

8. Input-markt onzekerheden
De onzekerheden op de input-markt verwijzen naar onzekerheden omtrent de verwerving van zowel adequate hoeveelheden als kwaliteit van grondstoffen, personeel, etc. De input-markt onzekerheden kunnen ontstaan als gevolg van wisselingen in leveranciers en van wisselingen in de vraag naar input.

9. Afzetmarkt onzekerheden
De onzekerheden op de afzetmarkt ontstaan als gevolg van onverwachte wijzigingen in de vraag naar de produkten van een bedrijfstak. Zulke wijzigingen kunnen ontstaan als gevolg van de ontwikkelingen in de smaak van consumenten en de beschikbaarheid van substituutproducten.

10. Onzekerheden omtrent concurrenten
Onzekerheden omtrent de concurrenten zijn geassocieerd met de bestaande concurrentieverhoudingen (intensiteit, voorspelbaarheid van gedrag van huidige concurrenten) en met de mogelijkheden voor nieuwe concurrenten om in de bedrijfstak te gaan opereren (toetredingsbarrières).

Bij vraag 14 van de enquête:

11. Operationele onzekerheden
De operationele onzekerheden van een organisatie-onderdeel kunnen worden gesplitst in drie subcategorieën:

- arbeidsonzekerheden: de onzekerheden omtrent arbeid is vaak niet bedrijfstakbreed, maar specifiek voor een organisatie-onderdeel. Arbeidsonzekerheden komen voort uit onverwachte wijzigingen in de produktiviteit van werknemers als gevolg van stakingen, arbeidsonrust en onveilige werkomstandigheden.
- grondstoffenonzekerheden: deze onzekerheden zijn eveneens vaak specifiek voor een organisatie-onderdeel. Gedacht kan worden aan zaken als tekorten aan grondstoffen, kwaliteitswisselingen en beperkingen in reserve-onderdelen.
- produktie-onzekerheden: deze onzekerheden worden veroorzaakt door bijvoorbeeld machinefouten, computerstoringen, ongelukken en andere verstoringen van het produktieproces.

12. Aansprakelijkheidsonzekerheden
Onzekerheden met betrekking tot de aansprakelijkheid worden veroorzaakt door onverwachte schadelijke effecten van de produktie van het organisatie-onderdeel, of consumptie van de producten van het organisatie-onderdeel. In dat verband kan worden gedacht aan zaken als produktaansprakelijkheid en milieu-aansprakelijkheid.

13. R&D onzekerheden
Deze onzekerheden worden veroorzaakt door het feit dat er niet altijd een eenduidige relatie is te leggen tussen de investering in R&D en het succes van nieuwe producten of procesverbeteringen. Het betreft zowel onzekerheden in de tijd (de voortgang van het project) als onzekerheden omtrent het uiteindelijke resultaat.

14. Kredietonzekerheden
Kredietonzekerheden verwijzen naar onzekerheden omtrent het incasseren van openstaande vorderingen (denk aan faillissementen van klanten).

15. Gedragsonzekerheden
De gedragsonzekerheden komen voort uit het feit dat managers en medewerkers van het organisatie-onderdeel geprikkeld worden om persoonlijke doelstellingen na te jagen, ten koste van de doelstellingen van de organisatie als geheel of de eigenaars (agency-theorie).

Bij vraag 16 van de enquête:

16. Terugverdientijd (payback period)
De tijd die nodig is om uit de netto ontvangsten van een investering de investeringsuitgave terug te verdienen.

17. Boekhoudkundig rendement (accounting rate of return)
De som van de jaarlijks verwachte winsten gedeeld door de oorspronkelijke investeringsuitgave.

18. Winstgevendheidsindex (profitability index)
De contante waarde van de toekomstige opbrengsten gedeeld door de contante waarde van de investeringsuitgaven.

19. Interne rentevoet (internal rate of return)
Het rendement op een investering in activa. De interne rentevoet wordt berekend als de disconteringsvoet waarbij de contante waarde van de toekomstige kasstromen gelijk is aan de kosten van de investering.

20. Netto contante waarde (discounted cash flow)
De waarde van een investering, welke wordt berekend door de contante waarde van de toekomstige kasstromen te verminderen met de kosten van de investering.

21. Reële optiewaardering (real option theory)
Berekening van de contante waarde van een investeringsproject, dat wordt gezien als de som van de waarde van het project zelf en de aanvullende optiewaarde die het betreffende project heeft voor het organisatie-onderdeel (denk aan zaken als uitbreidingsinvesteringen, marktverkenning, etc.).

22. Speltheoretische beslissingsregels
Speltheoretische beslissingsregels bieden de mogelijkheid om tot beslissingen te komen wanneer objectieve data omtrent kansverdelingen voor verschillende "states of the world" ontbreken. Voorbeelden van speltheoretische beslissingsregels betreffen de maximax-regel, de maximin regel, etc.

23. Niet-financiële beslissingsregels
Niet-financiële beslissingsregels zijn regels en richtlijnen die tot een beslissing leiden, welke niet afhankelijk is van bepaalde financiële gegevens. Gedacht kan worden aan beslissingen die leiden tot een maximalisering van het marktaandeel of tot het implementeren van de gekozen strategie.

Bij vraag 17 van de enquête:

24. Zekerheidsequivalenten
Een zekerheidsequivalent is het bedrag (of het rendement) dat iemand 'met zekerheid' zou eisen om hem/haar indifferent te doen zijn tussen deze zekere som (of dit zekere rendement) en een bepaalde onzekere, riskante som (dito rendement).

APPENDICES TO CHAPTER 5

CAPITAL BUDGETING PRACTICES AND DECISION MAKING

Appendix 5.1 Constituent Parts of Uncertainty

The next tables present the results on the constituent parts of uncertainty after the specific uncertainties have been dichotomized. That is, the Likert-scores used in section 5.3.1 have been regrouped in two groups of similar size (0 and 1). The next tables present the results (total variance explained, component matrix and rotated component matrix with respectively eigenvalue >1 and eigenvalue > 1.5).

Eigenvalue > 1

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,961	17,418	17,418	2,961	17,418	17,418	2,267	13,335	13,335
2	2,021	11,887	29,305	2,021	11,887	29,305	1,973	11,604	24,939
3	1,656	9,738	39,044	1,656	9,738	39,044	1,899	11,169	36,107
4	1,384	8,139	47,183	1,384	8,139	47,183	1,440	8,470	44,577
5	1,146	6,739	53,922	1,146	6,739	53,922	1,375	8,088	52,665
6	1,092	6,422	60,344	1,092	6,422	60,344	1,305	7,679	60,344
7	,956	5,626	65,970						
8	,818	4,813	70,782						
9	,796	4,680	75,463						
10	,707	4,157	79,619						
11	,641	3,769	83,388						
12	,629	3,701	87,089						
13	,553	3,252	90,341						
14	,534	3,141	93,482						
15	,449	2,640	96,121						
16	,378	2,222	98,343						
17	,282	1,657	100,000						

Extraction Method: Principal Component Analysis.

Component Matrix [a]

	Component					
	1	2	3	4	5	6
Political uncertainties	,349	,478	,446	,110	,106	,225
Policy uncertainties	-2,928E-02	,387	,312	1,900E-02	,186	,699
Exchange rate uncertainties	,392	,135	-,402	-,309	,291	-3,821E-02
Interest uncertainties	,335	,492	-,566	-,115	-8,151E-02	3,392E-02
Inflation uncertainties	,433	,396	-,557	-,123	-2,008E-02	,257
Social uncertainties	,291	,364	,496	8,694E-02	,278	-,288
Natural uncertainties	,435	,432	,269	-8,956E-02	-,244	-,129
Input market uncertainties	,454	-,526	5,888E-02	-3,797E-02	3,560E-02	,259
Output market uncertainties	,292	-,394	-,254	,521	,289	5,224E-02
Competitive uncertainties	6,460E-03	7,754E-02	-,131	,601	,529	-7,611E-03
Labor uncertainties	,662	-,166	,228	,119	-1,101E-02	-3,534E-02
Input uncertainties	,502	-,456	7,999E-02	-,221	4,865E-02	-6,990E-02
Production uncertainties	,474	-,356	6,660E-02	-,244	4,520E-02	,209
Liability uncertainties	,436	-,274	9,085E-02	8,478E-03	-,249	,291
R&D uncertainties	,360	3,364E-02	4,474E-02	-,459	,527	-,299
Credit uncertainties	,469	,115	-,272	,454	-,225	-9,785E-02
Behavioral uncertainties	,604	,126	,129	,243	-,334	-,285

Extraction Method: Principal Component Analysis.
a 6 components extracted.

Rotated Component Matrix [a]

	Component					
	1	2	3	4	5	6
Political uncertainties	1,529E-02	,433	2,761E-02	,647	1,002E-02	,124
Policy uncertainties	-5,469E-03	-,127	4,865E-02	,863	-2,164E-02	-9,352E-02
Exchange rate uncertainties	,146	-4,014E-02	,564	-6,460E-02	5,149E-02	,408
Interest uncertainties	-,129	,162	,808	-9,095E-03	-2,932E-02	1,570E-02
Inflation uncertainties	7,384E-02	7,087E-02	,842	,125	2,590E-02	-1,684E-02
Social uncertainties	-,127	,522	-,185	,300	8,267E-02	,459
Natural uncertainties	1,289E-02	,615	,156	,204	-,275	,108
Input market uncertainties	,734	-3,241E-02	-3,323E-02	-9,679E-03	,125	-4,104E-03
Output market uncertainties	,324	-9,388E-03	3,722E-02	-,155	,725	-7,673E-02
Competitive uncertainties	-,200	-1,934E-03	-1,009E-03	,135	,774	8,159E-02
Labor uncertainties	,524	,468	-1,091E-02	4,712E-02	,150	,122
Input uncertainties	,639	,103	-2,894E-02	-,196	-2,005E-02	,253
Production uncertainties	,656	-5,221E-03	7,348E-02	3,531E-02	-5,517E-02	,144
Liability uncertainties	,581	,159	5,042E-02	7,691E-02	-4,607E-02	-,217
R&D uncertainties	,163	3,397E-02	,140	-3,404E-02	-3,129E-02	,813
Credit uncertainties	9,338E-02	,495	,341	-,146	,340	-,260
Behavioral uncertainties	,195	,763	,103	-,113	3,679E-02	-6,125E-02

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 15 iterations.

Eigenvalue > 1,5

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,961	17,418	17,418	2,961	17,418	17,418	2,590	15,237	15,237
2	2,021	11,887	29,305	2,021	11,887	29,305	2,029	11,935	27,172
3	1,656	9,738	39,044	1,656	9,738	39,044	2,018	11,872	39,044
4	1,384	8,139	47,183						
5	1,146	6,739	53,922						
6	1,092	6,422	60,344						
7	,956	5,626	65,970						
8	,818	4,813	70,782						
9	,796	4,680	75,463						
10	,707	4,157	79,619						
11	,641	3,769	83,388						
12	,629	3,701	87,089						
13	,553	3,252	90,341						
14	,534	3,141	93,482						
15	,449	2,640	96,121						
16	,378	2,222	98,343						
17	,282	1,657	100,000						

Extraction Method: Principal Component Analysis.

Component Matrix [a]

	Component		
	1	2	3
Political uncertainties	,349	,478	,446
Policy uncertainties	-2,928E-02	,387	,312
Exchange rate uncertainties	,392	,135	-,402
Interest uncertainties	,335	,492	-,566
Inflation uncertainties	,433	,396	-,557
Social uncertainties	,291	,364	,496
Natural uncertainties	,435	,432	,269
Input market uncertainties	,454	-,526	5,888E-02
Output market uncertainties	,292	-,394	-,254
Competitive uncertainties	6,460E-03	7,754E-02	-,131
Labor uncertainties	,662	-,166	,228
Input uncertainties	,502	-,456	7,999E-02
Production uncertainties	,474	-,356	6,660E-02
Liability uncertainties	,436	-,274	9,085E-02
R&D uncertainties	,360	3,364E-02	4,474E-02
Credit uncertainties	,469	,115	-,272
Behavioral uncertainties	,604	,126	,129

Extraction Method: Principal Component Analysis.
a 3 components extracted.

Rotated Component Matrix [a]

	Component		
	1	2	3
Political uncertainties	3,266E-02	,739	4,221E-02
Policy uncertainties	-,223	,439	-7,481E-02
Exchange rate uncertainties	,176	-9,996E-03	,550
Interest uncertainties	-,107	9,362E-02	,809
Inflation uncertainties	3,049E-02	7,743E-02	,805
Social uncertainties	6,287E-02	,674	-7,432E-02
Natural uncertainties	,108	,631	,196
Input market uncertainties	,684	-,117	-6,982E-02
Output market uncertainties	,440	-,299	,151
Competitive uncertainties	-5,795E-02	-3,127E-02	,138
Labor uncertainties	,646	,311	6,227E-02
Input uncertainties	,681	-3,808E-02	-3,152E-02
Production uncertainties	,596	7,086E-03	1,118E-02
Liability uncertainties	,520	5,981E-02	1,184E-02
R&D uncertainties	,266	,198	,150
Credit uncertainties	,264	9,274E-02	,479
Behavioral uncertainties	,411	,412	,242

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 5 iterations.

Appendix 5.2 Industry and Capital Budgeting Practices

The next table presents the cross-tabulation on industry and capital budgeting practices. The table presents the actual observations in each industry; the actual observations are compared to the expected number of observations (calculated by multiplying the total number of observations in each industry by the overall distribution for capital budgeting practices). It is not possible to derive relevant statistics for the observations.

Industry				ARA-user		
Code	**Industry**		**SRA**	**PRA**	**GOTA**	**Total**
A	Agriculture and forestry	Actual count	1	-	-	1
		Expected count	0.6	0.4	0.1	1
C	Mining & processing	Actual count	-	-	1	1
		Expected count	0.6	0.4	0.1	1
D	Manufacturing	Actual count	48	28	2	78
		Expected count	43.0	29.4	5.5	78
E	Public utilities	Actual count	8	5	1	14
		Expected count	7.7	5.3	1	14
F	Construction & building	Actual count	2	5	1	8
		Expected count	4.4	3.0	0.6	8
G	Wholesale & resale trade	Actual count	10	9	0	19
		Expected count	10.5	7.2	1.3	19
I	Transport & communication	Actual count	7	4	0	11
		Expected count	6.1	4.1	0.8	11
J	Finance & Insurance	Actual count	10	9	5	24
		Expected count	13.2	9.0	1.7	24
K	Leasing & professional	Actual count	6	7	2	15
	services	Expected count	8.3	5.7	1.1	15
L	Government, non-profit and	Actual count	9	2	1	12
	other services	Expected count	6.7	4.5	0.8	12
	Total		101	69	13	183

Figure 1: Industry and capital budgeting practices

Figure 1 does not indicate that capital budgeting practices differ among industries. That is, the expected count is relatively close to the actual number of observations in the industries. In addition, the χ^2-test does not reveal any differences between primary, secondary and tertiary industry ($P>0.15$).

Appendix 5.3 Comparison of β with uncertainty factors (Likert-scores)

The next table provides a comparison of β with RUS, as well as with the original Likert-scores on the specific uncertainties that impact capital budgeting practices.

Pearson Correl.	β	Exch uncrtty	Interest uncrtty	Infl uncrtty	Output uncrtty	Liab uncrtty	Credit uncrtty	Behav uncrtty
β	1,000							
RUS	,473 *							
Exch uncertty	,373	1,000						
Interest uncertty	,379	,402 **	1,000					
Infl uncertty	,387	,480 **	,712 **	1,000				
Output uncertty	,368	,096	,049	,141	1,000			
Liab uncertty	,530 **	,047	-,003	,002	,141	1,000		
Credit uncertty	,116	,295 **	,310 **	,358 **	,187 *	,075	1,000	
Behav uncertty	,102	,134	,319 **	,316 **	,103	,140	,323 **	1,000

* = Correlation is significant at the 0.05 level (2-tailed); ** = Correlation is significant at the 0.01 level (2-tailed).

Pearson correl. = Pearson correlation; β= β of organizations;
RUS = relevant uncertainty score (sum of relevant uncertainties, Likert-scores); Exch uncerrty = exchange rate uncertainty;
Interest uncrtty = interest uncertainty; Infl uncrtty = inflation uncertainty; Output uncrtty = output uncertainty;
Liab uncrtty = liability uncertainty; Credit uncrtty = credit uncertainty; Behav uncrtty = behavioral uncertainty.

Again, (as with BRUS) there seem to be both similarities as well as differences between β as a measure of uncertainty and the RUS of an organization. The correlation between the RUS and β is significant at the 5% level; this indicates that β as well as RUS is an indicator for the uncertainty that organizations face. For RUS, β correlates only with liability uncertainty at the 5%-level. The data suggest that β only capture these uncertainty elements; other uncertainties do not seem to be represented as well by β. The results for RUS are therefore fairly similar to the results for BRUS.

APPENDICES TO CHAPTER 6

CAPITAL BUDGETING AND PERFORMANCE

Appendix 6.1 Summary statistics of the variables under study

The next table provides summary data of the variables under study. The table displays the number of observations, mean, standard deviation, and observed minimum and maximum.

Variable	Number of observations	Mean	Standard deviation	Observed minimum	Observed maximum
Uncertainty					
Relevant uncertainty score (original)	187	22.13	4.13	11.00	33.00
Relevant uncertainty score (binary, matched pairs)	187	3.26	1.82	0.00	7.00
Capital budgeting practices					
Capital budgeting practices (discrete: 1=SRA, 2=PRA)	185	1.45	0.50	1.00	2.00
Advancedness of capital budgeting practices (total number of uncertainty techniques)	180	43.46	9.68	17.00	75.00
Financial performance					
ROE	67	21.72	36.63	-30.01	216.95
ROA	67	8.42	7.24	0.37	38.05
$RTVR_{ROE}$	69	1.45	2.40	-2.12	12.27
$RTVR_{ROA}$	69	-.42	2.94	-12.88	6.23
Effectiveness					
Operating profit, profit margin	182	3.54	.84	1.00	5.00
Cash flow	182	3.55	.77	2.00	5.00
Shareholder value, dividends	161	3.35	.99	1.00	5.00
Cost reduction	184	3.24	.84	1.00	5.00
Sales growth rate	181	3.37	.78	1.00	5.00
Market share	180	3.33	.77	1.00	5.00
Development of new markets and products	180	3.18	.76	1.00	5.00
R&D	180	3.11	.76	1.00	5.00
Quality, customer/public value	184	3.48	.75	1.00	5.00
Personnel/HRM	184	3.26	.77	1.00	5.00
Public effects	180	3.23	.69	1.00	5.00
Ethics	180	3.62	.69	1.00	5.00
Aggregate effectiveness a)	153	3.38	.42	2.27	4.88

a): aggregate effectiveness is calculated as a weighted average of effectiveness response with criterion importance serving as weights.

Table 6.1: *Summary statistics on variables under study*

Appendix 6.2 Correlations between variables

The next figure presents the correlations between the variables under study.

Variable	RUS	BRUS	CB (SRA, PRA, GOTA)	Advanc CB pract	ROE	ROA	RTVR ROE	RTVR ROA
BRUS	.89 **							
CB (SRA, PRA, GOTA)	.29 **	.26 **						
Advancedness CB practices	.27 **	.22 **	.63					
ROE	-.04	.04	.17	.09				
ROA	-.05	.02	.19	.10	.88 **			
RTVR $_{ROE}$	.04	.08	-.03	-.02	.22	.27 *		
RTVR $_{ROA}$	.07	.04	.12	.03	.41 **	.62 **	.23	
Aggregate effectiveness	.00	.05	.02	.02	.39 **	.34 **	.30 *	.07

RUS = relevant uncertainty score (original scores); BRUS = binary relevant uncertainty score;
CB (SRA, PRA, GOTA) = capital budgeting practices (SRA=1, PRA=2, GOTA=3);
Advancedness CB practices = total number of uncertainty techniques used (continuous variable);
ROE = average return on equity 1992-1997; ROA = average return on assets 1992-1997;
RTVR $_{ROE}$ = reward-to-variability-ratio for ROE; RTVR $_{ROA}$ = reward-to-variability-ratio for ROA;
Aggregate effectiveness = effectiveness measure.
* = significant at 5%-level; ** = significant at 1%-level.

Table6.2: *Correlation between variables*

Appendix 6.3 Quality of matches

The next figures provide some information on the quality of the matches. The columns (3) to (6) provide the ratios of the matching criterion. The matching ratios are calculated by dividing the score for the control organization (i.e., SRA-user) by the score for the experimental organization (i.e., ARA-user). For example, the matching ratio in column (4) is calculated by dividing the asset size of the control organization by the asset size of the experimental organization. The closer the matching ratio is to one, the better matched the two organizations are on the variable in question.

(1) Matched pair number	(2) Industrial code (SIC)	(3) Technology	(4) Size	(5) Investment strategy	(6) Uncertainty
1	15	1/1	0,28105	3/2	2/1
2	15	1/3	0,20798	1 /2	4/6
3	21	1/1	0,99835	2/2	4/6
4	22	1/1	1,56535 (a)	4/3	3 /4
5	22	1/1	0,40120	3 /4	2/1
6	24	2/2	1,42857	4/2	3/2
7	24	3/3	0,77707	2/2	6/7
8	24	2/2	1,22500	3 /4	1 /2
9	25	*2/1 (d)*	3,60889 (b)	2/1	*3/5 (d)*
10	28	1/1	0,48193	1 /2	2 /3
11	28	*2/3 (d)*	0,63529	3 /4	4/4
12	28	*2/3 (d)*	0,33708	2/2	5/6
13	31	1/1	0,26049	1/1	3/1
14	35	1/3	0,42675	3/2	2/1
15	40	1/1	0,30833	3 /4	*2/4 (d)*
16	45	1/1	2,52071	4/3	1/3
17	45	*2/3 (d)*	3,63636	4/3	4/4
18	50	1/3	0,41509	2/4	5/5
19	51	1/3	1,73913	2/2	2/2
20	51	2/2	0,30043	2/4	4/6
21	52	*N.A. (c) / 2 (d)*	0,36000	1/1	*3 /4 (d)*
22	52	1/1	0,80165	4/1	1/3
23	60	1/1	0,20151	3 /4	2/2
24	66	3/1	0,54000	3/3	5/5
25	66	1/3	0,67059	4/2	4/4
26	66	1/3	0,36087	4/ N.A. (c)	1/1
27	66	1/1	0,91250	2/1	4/5
28	72	1/3	0,35556	2/1	*4/3 (d)*
29	74	1/1	0,81557	1 /4	1/0

Technology: fertile (1), turbulent (2) or stable/long-lived (3).
Size: measured by total assets.
Investment strategy: insurance approach (1), dedicated approach (2), incremental approach (3) or opportunistic approach (4).
Uncertainty: sum of binary values for relevant uncertainties.
(a): size ratio is based on comparison of sales of experimental organization and control organization;
(b): size ratio is based on comparison of number of employees of experimental organization and control organization;
(c): information on either technology or investment strategy is not available.
(d): matches do not fit "rigid matching criteria".

Table 6.3: *Information on matched organizations for evaluation of effectiveness*

The selected organizations in the "effectiveness sample" are active in manufacturing (48%), repair of consumer articles and trade (17%), financial services (14%), construction (7%), computer services/professional services (7%), public utilities (3%) and transport, storage and communication (3%).

The next table provides information on the quality of the matches between the organizations for the evaluation of financial performance.

(1) Matched pair number	(2) Industrial code (SIC)	(3) Technology	(4) Size	(5) Investment strategy	(6) Uncertainty
1	15	1/3	0,5114	3/4	*0/4 (b)*
2	15	1/1	0,2811	3/2	2/1
3	15	1/3	0,2080	1/2	4/6
4	15	*2/1 (b)*	0,8466	4/2	*1/5 (b)*
5	21	1/1	0,9983	2/2	4/6
6	22	*2/1 (b)*	0,4318	*1/3 (b)*	*2/4 (b)*
7	22	1/1	0,4012	3/4	2/1
8	24	2/2	1,2250	3/4	1/2
9	28	1/1	0,4819	1/2	2/3
10	28	*2/3 (b)*	0,6353	3/4	4/4
11	35	*2/3 (b)*	0,8810	3/2	*4/1 (b)*
12	40	1/1	0,3083	3/4	*2/4 (b)*
13	40	1/1	2,0860	3/3	*2/5 (b)*
14	45	1/1	2,5207	4/3	1/3
15	50	1/3	0,4151	2/4	5/5
16	50	1/3	0,5707	2/4	*3 /4 (b)*
17	51	1/3	1,7391	2/2	2/2
18	51	2/2	0,3004	2/4	4/6
19	52	1/1	0,8016	4/1	1/3
20	52	NA/2 (a)	0,3600	1/1	*3/4 (b)*

(a): information on technology is not available.
(b): matches do not fit the "rigid matching criteria".

Table 6.4: *Information on matched organizations for evaluation of financial performance*

In the "financial performance sample", 55% of the organizations is active in manufacturing, 30% is active in repair of consumer articles and trade, 10% is a public utility and 5% is working in construction.

Appendix 6.4 Empirical patterns for SRA- and ARA- (PRA- and GOTA-) users

The next table presents the empirical patterns for the 15 highest-performing organizations in each category (SRA- and ARA-users). In addition, the group of 15 ARA-users has been split in a group of 15 PRA-users and a group of 5 GOTA-users. The last group is too small (N=13) to derive an empirical pattern for a larger group high-performing organizations. The empirical pattern provided for GOTA-users represents about 30% of the total population of GOTA-users.

		ARA-users			Anova Test Results (SRA vs. ARA)		Anova Test Results (SRA, PRA, GOTA)	
	SRA-user (N=15)	ARA-users (N=15)	PRA-user (N=15)	GOTA-user (N=5)	F-rati	P	F-ratio	P
Uncertainty								
3. Total (RUS, 2 groups)	1.33	1.60	1.73	1.60	2.15	.15	2.61	.09
4.a Exchange rate a)	1.33	1.47	1.67	1.40	.53 (5.47)	.47 (.03)	1.78	.19
4.b Interest	1.60	1.40	1.40	1.60	1.17	.29	.65	.53
4.c Inflation	1.53	1.60	1.67	1.60	.13	.72	.26	.77
4.d Output market	1.47	1.87	1.87	1.80	6.15	.02	3.26	.05
4.e Liability	1.33	1.53	1.60	1.60	1.19	.29	1.20	.32
4.f Credit	1.20	1.20	1.20	1.60	.00	1.00	1.83	.18
4.g Behavior	1.60	1.60	1.60	1.60	.00	1.00	.00	1.00
Environment								
5. Dynamism	1.60	2.00	1.93	2.00	9.33	.01	3.77	.03
6. Heterogeneity	1.80	2.00	1.93	2.00	3.50	.07	1.00	.38
7. Technology	1.57	1.60	1.60	1.60	.02	.88	.01	.99
Strategy								
8. Objectives								
8.a Profit, profit margin	1.40	1.67	1.67	1.80	2.15	.15	1.73	.19
8.b Operational cash flows	1.20	1.40	1.40	1.20	1.40	.25	.81	.46
8.c Dividends, shareholder value	1.33	1.73	1.80	1.80	5.36	.03	4.57	.02
8.d Cost reduction	1.40	1.47	1.33	1.40	.13	.72	.08	.93
9. Corporate strategy	1.40	1.40	1.47	1.40	.00	1.00	.07	.93
10. Business unit strategy	1.29	1.43	1.46	1.20	.59	.45	.70	.51
11. Investment strategy	1.14	1.27	1.27	1.20	.65	.43	.32	.73
12. Size	1.53	1.62	1.62	1.50	.18	.68	.54	.59

Total uncertainty: RUS, divided in two groups ("low" and "high" uncertainty group);
Environment: dynamism: stable group (1) and dynamic group (2); heterogeneity: simple group (1) and complex group (2);
Technology: stable, long-lived/fertile technology group (1) and turbulent technology group (2);
Corporate strategy: single business group (1) and an (un)related diversified group (2);
Business unit strategy: build group (1) and hold/harvest group (2);
Investment strategy: incremental/dedicated/opportunistic group (1) and insurance group (2).
The number between brackets (.) refer to the test results for the "original scores" from 1-5 (only in case of large differences).
a): the difference is due to the fact that SRA-users hardly experience exchange rate uncertainty (average 2.5), while exchange rate uncertainty has a relatively large impact on ARA-users (average 3.5).

Table 6.5: *Patterns for mean of variables for high-performing SRA-, PRA- and GOTA-users*

Appendix 6.5 Correlations between variables

The next table presents the correlations between a number of performance measures and the deviations from the ideal patterns described in chapter 6.

		A	B	C	D	E	F	G	H
A	Effectiveness								
B	ROE	,393 **							
C	$RTVR_{ROE}$	,301 *	,218						
D	ROA	,338 **	,884 **	,272 **					
E	$RTVR_{ROA}$	,069	,411 **	,227	,623 **				
F	Deviation from empirical SRA-profile	,050	-,227	,187	-,161	,019			
G	Deviation from theoretical SRA-profile	-,024	-,007	,309	,030	,089	,327 **		
H	Deviation from empirical ARA-profile	-,336 *	-,083	,154	,150	,275	, a	, a	
I	Deviation from theoretical ARA-profile	-,335 *	-,177	,114	-,133	-,101	, a	, a	,675 **

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

a Cannot be computed because at least one of the variables is constant.

F = squared root of sum of squared difference between variable and empirical ideal pattern for SRA (empirical ideal pattern: RUS=1.33; dynamism = 1.60; heterogeneity = 1.80; technology = 1.57; profit = 1.40; OCF = 1.20; dividends = 1.33; costs = 1.40; corporate strategy = 1.40; business unit strategy = 1.29; investment strategy = 1.14; size = 1.53).

G = squared root of sum of squared difference between variable and theoretical ideal pattern for SRA (theoretical pattern: RUS, dynamism, heterogeneity, technology, profit, costs, investment strategy and size = 1).

H = squared root of sum of squared difference between variable and empirical ideal pattern for ARA (empirical ideal pattern: RUS=1.60; dynamism = 2.00; heterogeneity = 2.00; technology = 1.60; profit = 1.67; OCF = 1.40; dividends = 1.73; costs = 1.47; corporate strategy = 1.40; business unit strategy = 1.43; investment strategy = 1.27; size = 1.62).

I = squared root of squared difference between variable and theoretical ideal pattern for ARA (theoretical pattern: RUS, dynamism, heterogeneity, technology, profit, operational cash flows, dividends, investment strategy and size = 2).

The results indicate that a deviation from the ideal pattern results in a lower effectiveness for ARA-users. The results for the other variables are not significant.

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The purpose of this study is to develop a better understanding of the way in which uncertainty affects the design and use of elements of the management accounting system, i.e. capital budgeting practices. The study investigates if uncertainty (separately or in combination with other contingency factors) affects capital budgeting practices and, if so, if it has an impact on performance. A theoretical framework has been developed to examine the relationships between uncertainty, other contingencies, capital budgeting practices and performance.

The theoretical framework has been verified empirically; the resulting "multiple contingency profile" developed in this research project identifies the specific uncertainties that affect capital budgeting practices, as well as the relationships between uncertainty and other variables that affect capital budgeting practices. As a result, organizations are provided with insight in the (ex ante) determinants of their capital budgeting practices instead of being confronted with an ex post resultant for uncertainty. The findings support the theory that there are relationships between uncertainty, other contingency factors and capital budgeting practices; however, an "appropriate match" between these variables does not necessarily result in a higher performance.

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